

## REVISION OF THE MALESIAN AND THAI SPECIES OF *SAUROPUS* (EUPHORBIACEAE: PHYLLANTHOIDEAE)

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### SUMMARY

Fourteen species of *Sauropus* are recognised for Malesia, 21 for Thailand. Two species are described as new, *S. asymmetricus* of Sumatra and *S. shawii* of Borneo. Many new synonyms, especially for *S. androgynus* and *S. rhamnoides*, are provided. The latter two species have a much wider distribution than described before and both are difficult to separate from each other. A phylogeny based on morphological and palynological data proved futile, but showed that *Sauropus* together with *Breynia* and *Glochidion* are embedded in the paraphyletic *Phyllanthus*. Most species which formerly belonged to *Synostemon* and are now included in *Sauropus* are probably, with the exception of *S. bacciformis*, related to *Breynia* and *Glochidion*. Because of the poor phylogenetic results the circumscription of *Sauropus* is not changed (*Synostemon* still included), and an infrageneric classification is not provided.

**Key words:** Euphorbiaceae, *Sauropus*, *Synostemon*, Malesia, Thailand.

### INTRODUCTION

Blume (1825) introduced *Sauropus* based on two species, *S. rhamnoides* and *S. albicans*. The latter, the lectotype of the genus (Webster, 1994), appeared to be a synonym of a taxon originally described by Linnaeus (1767) as a *Clutia*, the commonly known *S. androgynus* (L.) Merr. In the course of time various authors contributed taxa and presently about 70 species are known. The genus shows two distinct areas of speciation, one in Southeast Asia mainland (Thailand up to Vietnam) and one in Australia.

Almost all Australian species belong to what was formerly known as genus *Synostemon*, a genus described by Mueller (1858). Only two species of former *Synostemon* occur outside Australia, one in New Guinea (*Sauropus sphenophyllus* (Airy Shaw) Airy Shaw), and one ranging from Mauritius to central Indonesia, the in many ways aberrant *Sauropus bacciformis* (L.) Airy Shaw. The former *Synostemon* species differ from *Sauropus*, according to the keys, in the completely free sepals. In habit they look quite homogeneous and somewhat different from the other *Sauropus* species, because of the usually small, relatively narrow leaves. In *Sauropus* s.s. this is only found in *S. amoebiflorus* Airy Shaw. Airy Shaw considered these differences too small to merit a generic distinction, and in 1980 (Airy Shaw, 1980b) he united the two genera under *Sauropus*.

*Sauropus* is classified in subfamily Phyllanthoideae, tribe Phyllanthae, subtribe Flueggeinae Müll.Arg. (Webster, 1994; Radcliffe-Smith, 2001). Recent molecular phylogenetic analyses show the Phyllanthoideae to be a distinct monophyletic unit,

to be kept separate from the otherwise paraphyletic Euphorbiaceae (Euphorbiaceae s.s., the mono-ovulate Euphorbs, are monophyletic; e.g., Judd et al., 1999). A typical combination of characters for the genus is monoecy, a usually herb to shrub-like habit, a distichous aestivation, six imbricate sepals, disc absent or reduced to sepal scales in the staminate flowers, three stamens united, the free filament parts usually horizontally with abaxially the anthers, pollen 3–16-colporate with usually diploporate ecto-apertures (Sagun & Van der Ham, pers. comm.), pistillode absent, stigmas sessile, usually split and crescent moon-like, locules bi-ovulate; seeds intermediate between anacampylotropous and hemianatropous-campylotropous with a ‘partial’ white sarcotesta covering the chalazal end only (absent in *Sauropus bacciformis* and *S. huntii* (Ewart & O.B. Davies) Airy Shaw), chalaza bullate and protruding into seed, leaving a large cavity; testa with a typical spine-like wall formation arising from the inner wall of the inner testa-epidermis cells (Stuppy, 1995, pers. comm.).

Müller Argoviensis (1863, 1866) made the first infrageneric classification with three sections (*‘Eusauropus’*, *Ceratogynum*, and *Hemisauropus*). Hooker (1887) followed this classification, and Pax & Hoffmann (1922) modified the classification to two subgenera (*‘Holosauropus’* and *Hemisauropus*), with five sections in subgenus *‘Holosauropus’*. Airy Shaw (1969) only recognised sections (including *Hemisauropus*); he added a new section, *Glochidioidei*, corrected the section name *Ceratogynum* to *Cryptogynium*, and reduced a section of Pax & Hoffmann (*Sphaeranthi* as part of section *Sauropus* (*‘Eusauropus’*)). He also commented that the infrageneric classification still left much to desire for, e.g. section *Schizanthi* Pax & K. Hoffm., species with narrow and deeply incised calyx lobes, did not seem very natural. However, he suggested (1980b) that former *Synostemon* has to be classified in this same section, which repeated the seemingly unnaturalness of *Schizanthi*.

#### NOMENCLATURE AND SPECIES DELIMITATION

The distinction between the two widespread, variable and often quite similar species, *Sauropus androgynus* and *S. rhamnoides* Blume has caused quite some confusion. First of all, the range of *S. rhamnoides* appeared to be much wider than presumed before (Thailand, W Malesia): India to Lesser Sunda Islands and Philippines, completely overlapping with that of *S. androgynus*. On the Lesser Sunda Islands, *S. rhamnoides* was confused with *S. rostratus* Miq. (a species restricted to S Thailand and Sumatra) and in Thailand it was partly confused with *S. garrettii* Craib (a species absent from SW Thailand, only present in N Thailand up to S China). The Indian *S. lanceolatus* Hook.f. and the Vietnamese *S. hayatae* Beille are considered to be synonyms of *S. rhamnoides*. On the whole, the leaves, staminate flowers, pistillate flowers, and fruits of *S. rhamnoides* are larger than those of *S. androgynus*, but many exceptions occur, e.g., very large staminate flowers of *S. androgynus* in Thailand, and often small-leaved *S. rhamnoides* specimens in various parts of its distribution. The best distinctive character is in the leaf apex (Fig. 1). The leaf apex of *S. androgynus* is gradually tapering to an obtusely acute apex (Fig. 1a), the apex of *S. rhamnoides* leaves is acutely acuminate, with two subapical sinuses in the leaf margin (Fig. 1b). Unfortunately, the sinuses in the leaves disappear in the extremes of the distribution of *S. rhamnoides*: India, Philippines, and Lesser Sunda Islands (Fig. 1c); there the more acute leaf apex

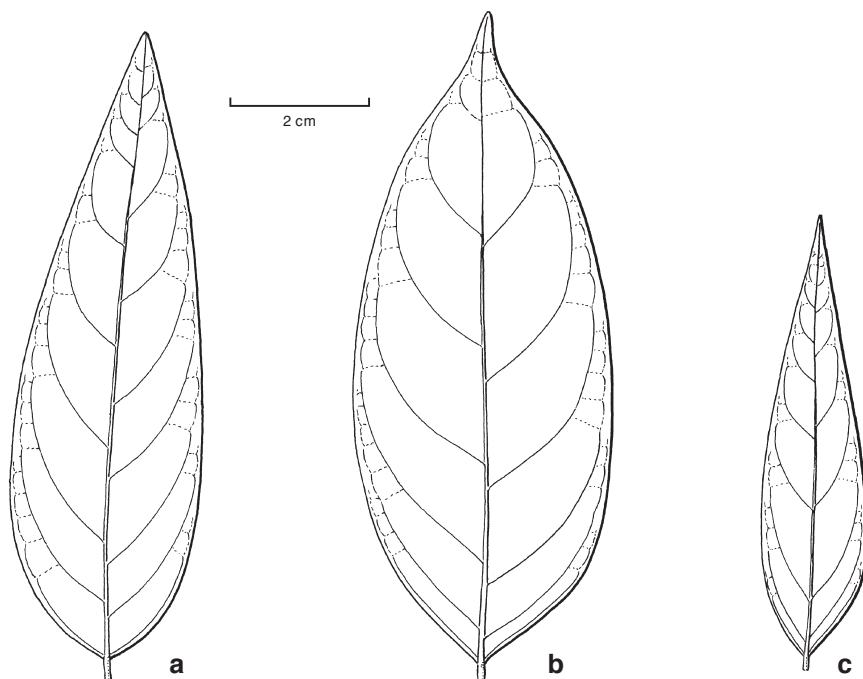


Fig. 1. Differences in leaf shape. — a. *Sauropus androgynus* (L.) Merr. Leaf tapering towards apex, very apex obtuse. — b, c: *S. rhamnoides* Blume. b. Leaf acuminate with two apical sinuses and an acute very apex; c. leaf from Lesser Sunda Islands, sinuses absent, acute very apex still present (a: Shimizu *et al.* T-21612; b: De Wilde & De Wilde-Duyffjes 13579; c: Schmutz 3392; all L).

and larger measures of the generative parts have to be used to differentiate between the two species. In India special forms, *S. retroversus* Wight (with a recurved staminate calyx) or *S. oblongifolius* Hook.f., appear not to be special and these names are now considered as synonyms of *S. androgynus*.

A more complicated nomenclatural problem is posed by the genus name *Aalius*. *Aalius* is a pre-Linnaean genus name of Rumphius (1743), used in two species descriptions, a small- and a large-leaved species (plates and a genus description are lacking). The description of the large-leaved species cannot be interpreted, because it only contains data about the relative leaf size and some bark and wood characteristics. Lamarck (1783) translated Rumphius' descriptions into French (but did not translate the fact that fallen leaves turn very black). Though Lamarck's publication is post-Linnaean, it still did not validate the name *Aalius* because a genus description was lacking. Hasskarl (1866) provided the correct binomials (*A. parvifolius* for the small-leaved species) and he thought that *A. parvifolius* could be identical with *Sauropus albicans* (a synonym of *S. androgynus*). Kuntze (1891) validated the genus (following Hasskarl's suggestion) by synonymising *Sauropus* with *Aalius*. This turns *Aalius* into a nomenclatural synonym of the older *Sauropus* (ICBN Art. 7.7, 32.1). The lectotype of *Aalius* should be *A. androgynus* (L.) Kuntze, the only new combination with a full description and also the species to which Hasskarl referred *A. parvifolius*. Merrill (1917a) reinterpreted Rumphius' names and considered *A. parvifolia* to be synonymous with *Breynia cernua*

(Poir.) Müll.Arg., a species in which the fruiting calyx increases in size and of which the leaves turn black (the fact omitted in Lamarck's translation). The increase in calyx is far less pronounced in *Sauropus* than in quite a few *Breynia* species, moreover, the blackening of the leaves does not occur in *Sauropus*. Therefore, it is quite likely that Merrill's interpretation of Rumphius' descriptions is more correct than that of Hasskarl and Kuntze. However, due to Kuntze, *Aalius* remains a synonym of *Sauropus*.

Another problematic name is *Breyniopsis*, a genus established by Beille (1925, 1927) with the Indochinese *B. pierrei* Beille as single species. Beille considered it related to *Breynia* but differing in the spreading outer sepals and inflexed inner sepals of which the inflexed apex has grown together with the rest of the blade along the midvein. Pax & Hoffman (1931) followed the suggestion made by the name and concluded that *Breyniopsis* might be a synonym of *Breynia*. Croizat (1940) was the first to point out the correct relationship. *Breyniopsis pierrei* is a *Sauropus* species, and, consequently, he made the new combination in *Sauropus*. The same combination was also published as new by Webster (1994), but the official reference should be *S. pierrei* (Beille) Croizat. *Sauropus pierrei* belongs to the *Hemisauiropus* group, for which the inflexed inner sepals and the lack of sepal scales are typical (this section still has the very typical *Sauropus* stamens).

Fischer (1927) described *Glochidion subterblancum* from Myanmar (Burma). Later, Fischer (1939), acting upon a hint by Croizat, transferred the species to *Breynia*, considering it to be very near to *B. glauca* Craib. The two species indeed share the ovate shape of the thick, glaucous leaves. However, *Breynia subterblancum* shows the same staminate flower as the *Hemisauiropus* group, with the scaleless sepals and inflexed inner sepals. Therefore, this species was transferred to *Sauropus* (Van Welzen, 2001) and it is the second large-leaved species in the *Hemisauiropus* group (*S. pierrei* is the other). It differs from *S. pierrei* by the glaucous leaves which are broader and relatively shorter with an acute instead of an acuminate apex. A third, large-leaved *Hemisauiropus* species will be described for Borneo in this paper: *Sauropus shawii* Welzen.

A delimitation problem was posed by *S. quadrangularis* (Willd.) Müll.Arg. Airy Shaw (1972) recognised three varieties (all former species) for Thailand: var. *quadrangularis*, var. *compressus* (Müll.Arg.) Airy Shaw, and var. *puberulus* Kurz. Variety *puberulus* has hairs, the other two are glabrous; variety *compressus* has flattened branches, the other two more or less round branches. The variability in Thailand is already to such an extent that the varieties cannot be distinguished. Specimens vary between densely hairy to a few hairs to glabrous and from round branches to completely flattened branches. Moreover, hairy and glabrous specimens have been found together, an indication that the presence of hairs may not be an important species character. *Sauropus quadrangularis* is sometimes difficult to separate from other species, especially from *S. brevipes* Müll.Arg., but *S. quadrangularis* is the only small-leaved *Sauropus* with erect stigmas, all other species have horizontal stigmas. Because of this typical character and all intermediates I merged all varieties. However, in India Chakrabarty & Gangopadhyay (1996) state that they are quite able to distinguish variety *compressus* as a species. However, the character they use, the presence of an incised or not incised staminate calyx lobe, is one of the variable characters in *S. quadrangularis*, ranging from a rounded apex to a deeply emarginate apex, and is unreliable to use for species delimitation.

## MORPHOLOGY

### *Habit and branches*

The habit varies from woody herbs to shrubs to trees and sometimes the plants are vine-like. Some species, especially the ones with long(er) inflorescences instead of fascicles, are small shrubs, often less than 1 m high, cauliflorous (often only at ground level) to ramiflorous (to axillary inflorescences). Some species smell like fenugreek (maggi), at least when dry, just like species in *Mallotus* section *Stylanthus*.

The young branchlets usually have 2 or 4 longitudinal ribs. These may be faint to very distinct. When 2 ribs are present then the branchlets are usually flattened. Species without ribs have round branches.

*Sauropus heteroblastus* Airy Shaw, a rheophyte, has extremely short branches, less than 5 mm long and usually with two leaves only, thus giving the impression of a leaved stem instead of leaved branches only.

### *Indumentum*

Most species are completely glabrous. An exception is *S. suberosus* Airy Shaw, in which the inflorescences can be somewhat hairy. Several species are very hairy and covered with simple, single, hirsute hairs. The species are either hairy or glabrous except for two species, which are variable for this character, they have glabrous and hairy specimens: *Sauropus calcareus* M.R. Hend. and *S. quadrangularis*.

Often typical for *Sauropus* is the presence of a kind of papillae, termed asperities in literature. These asperities are long, stiff papillae, present in species which possess them on young branchlets (either only on the ribs, between the ribs or on both), petioles, leaf margin and leaf midrib. The papillae/short hairs on the calices of some *Baccaurea* species resemble the asperities closest.

### *Leaves*

The leaves are simple, and usually distichous on at least the young branches, giving these branches the appearance of a compound leaf. The stipules are usually small, and caducous, often with eared basal margins, sometimes distinctly asymmetric. The petiole is kidney-shaped in transverse section (channelled above), glabrous or with asperities. The leaf margins are always entire and the blade lacks glands. The lower surface of the leaves is often covered with very short papillae (or dome-shaped epidermis cells), giving a glaucous to dull impression.

### *Inflorescences*

Most species have axillary fascicles with one to several flowers (Fig. 8a). In most species these can elongate into short racemes with apically usually staminate flowers only. Several species have very short to very long (up to 51 cm in *S. thyrsoflorus* Welzen) ramiflorous to cauliflorous racemes or are thyrsoid (Fig. 6, 7, 9). All flowers are in the axil of a single bract. The staminate flowers appear in the axils of the lower leaves, usually before the pistillate flowers start to flower. The pistillate flowers usually appear at the apex of the branches.

### *Flowers*

The flowers are usually minute, pedicelled, and actinomorphic. Petals and a pistillode are absent. A disc is absent in the pistillate flowers and transformed into calyx scales

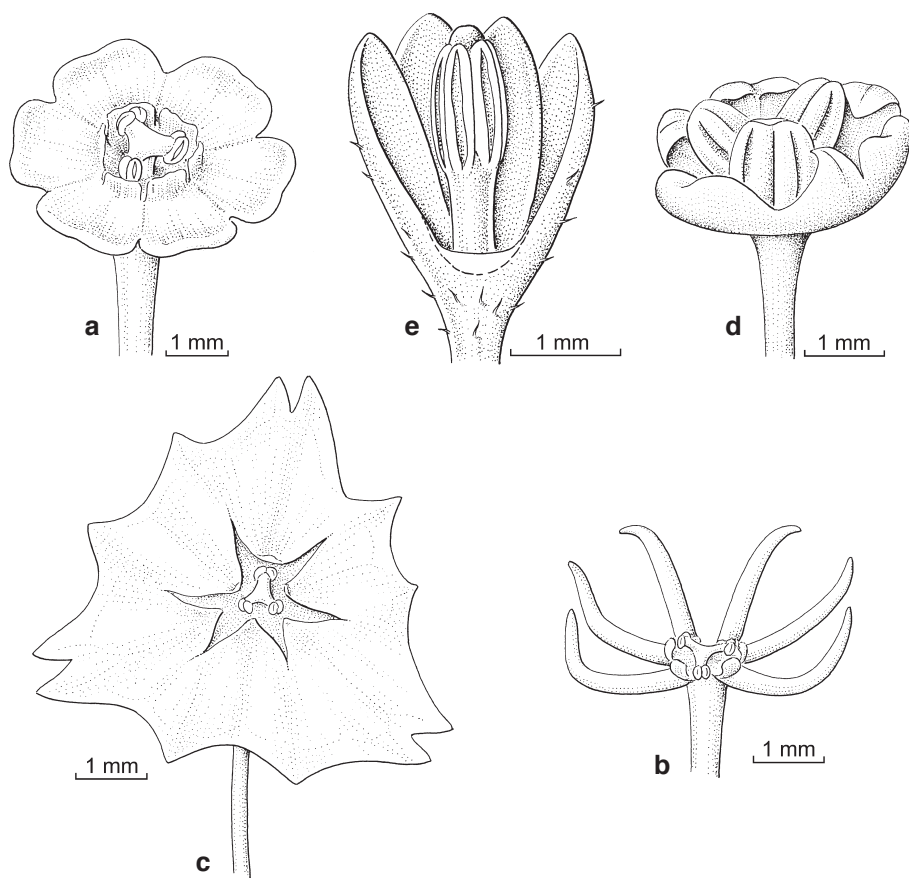


Fig. 2. Different staminate flower types. — a. *Sauropus bicolor* Craib. Common calyx type, with rounded lobe apices. — b. *S. micrasterias* Airy Shaw (*Schizanthi* group). Calyx lobes largely free, very narrow and thick. — c. *S. amoebiflorus* Airy Shaw. Lobes apically incised, three lobes reduced. — d. *S. pierrei* (Beille) Croizat (part of *Hemisauiropus* group). Calyx scales absent, apices of three lobes incurved and grown with blade via midvein, androecium much larger than in other species. — e. *S. elachophyllus* (F. Muell. ex Benth.) Airy Shaw var. *latior* Airy Shaw. Sepals free, erect, androecium *Breynia-Glochidion*-like (a: Maxwell 96-712, L; b: *S* (Erwin & Paul) 27479, L; c: Maxwell 92-429, L; d: Poilane 2442, P; e: Chippendale 8077, L).

in the staminate flowers except for the species in the *Hemisauiropus* group and most species in former *Synostemon*, where the scales are lacking. The pedicels are usually rather short (less than 2 cm) except in *S. macranthus* Hassk. (up to 7.5 cm; Fig. 3b).

### Calyx

The calyx is flat, disc-like (*Sauropus sphenophyllus* and the Australian species of former *Synostemon* excepted) and always has six imbricate lobes (Fig. 2, 3). The pistillate lobes are only basally connate and they usually have a spade-like apex; quite often three lobes are larger than the other three. The staminate calyx is quite variable, ranging from almost free and narrow lobes to almost completely connate and enlarged lobes:



- in former genus *Synostemon* the calyx lobes are more or less completely free. However, they vary strongly, in *Sauropus bacciformis* they spread, like in most *Sauropus* species; in New Guinean *Sauropus sphenophyllus* they probably remain erect (Fig. 2e);
- in the *Hemisauiropus* group the lobes are free for the larger part (Fig. 2d). Three lobes are straight or have a somewhat inflexed apex. The apex of the other three lobes is folded inward and grown together with the rest of the lobe via the midvein. Scales are lacking on the lobes;
- in the *Schizanthi* group the lobes are almost free, very narrow and long, and almost round in transverse section, basally they have large and obvious scales (Fig. 2b). However, this form may also appear in some of the Indian and Philippine specimens of *Sauropus androgynus* and *S. rhamnoides*, species which normally have a quite opposite calyx (see last item). It might be that this form is the primitive condition in the genus;
- most species have thick, rounded lobes which are united for 2/3rd and which basally carry a scale (Fig. 2a);
- in a few species the lobes of the former group become forked, noticeable in *Sauropus quadrangularis*, but most extreme in *S. amoebiflorus* and *S. asteranthos* Airy Shaw (Fig. 2c). In *S. amoebiflorus* three lobes are often somewhat reduced, shorter, giving the staminate flower a triangular appearance from above;
- a few species, e.g., *S. androgynus*, *S. discocalyx* Welzen, *S. garrettii*, and *S. rhamnoides* have enlarged calyces, up to 25 mm diam. (Fig. 6b, 8b). The lobes are almost completely grown together and the apex is rounded. In some forms (e.g., former *S. retroversus*) the calyx becomes revolute. The size of the calyx differs per area, usually the calices of *S. rhamnoides* are largest, but in some areas of Thailand those of *S. androgynus* are larger. These calyces also possess scales.

The calyx scales are probably derived from disc glands, but lost their secretory function. In young flowers they are adnate to the androecium, sealing off any premature pollen release, once the flower is mature the scales rise and the pollen is released.

#### *Androecium*

The three stamens are united into an androphore. Within the Malesian and Thai species three different androecium types are present:

- in most species the androphore is short and splits into three horizontal arms with the small anthers underneath the arms (Fig. 2a);
- in the *Hemisauiropus* group the anthers are much larger, on a longer androphore and the arms are oblique (Fig. 2d);
- in *S. sphenophyllus* the androecium is of the *Glochidion* type: an erect and sturdy androphore with the anthers along the androphore and an elongated connective, forming an extension above the anthers. This type is also almost alike *Breynia*, where the extension of the connectives is less distinct. *Sauropus sphenophyllus* might be referred to *Breynia*, also because of the gynoecium. However, the calyx lobes are almost free, though not spreading; in *Breynia* they are connate and turbinate (thus the overall shape of the flowers of both species is similar).

The pollen of *Sauropus* is like that of *Breynia*, with usually two pores per colpus, a very distinct and typical type within the Phyllanthoideae (Sagun, pers. comm.).

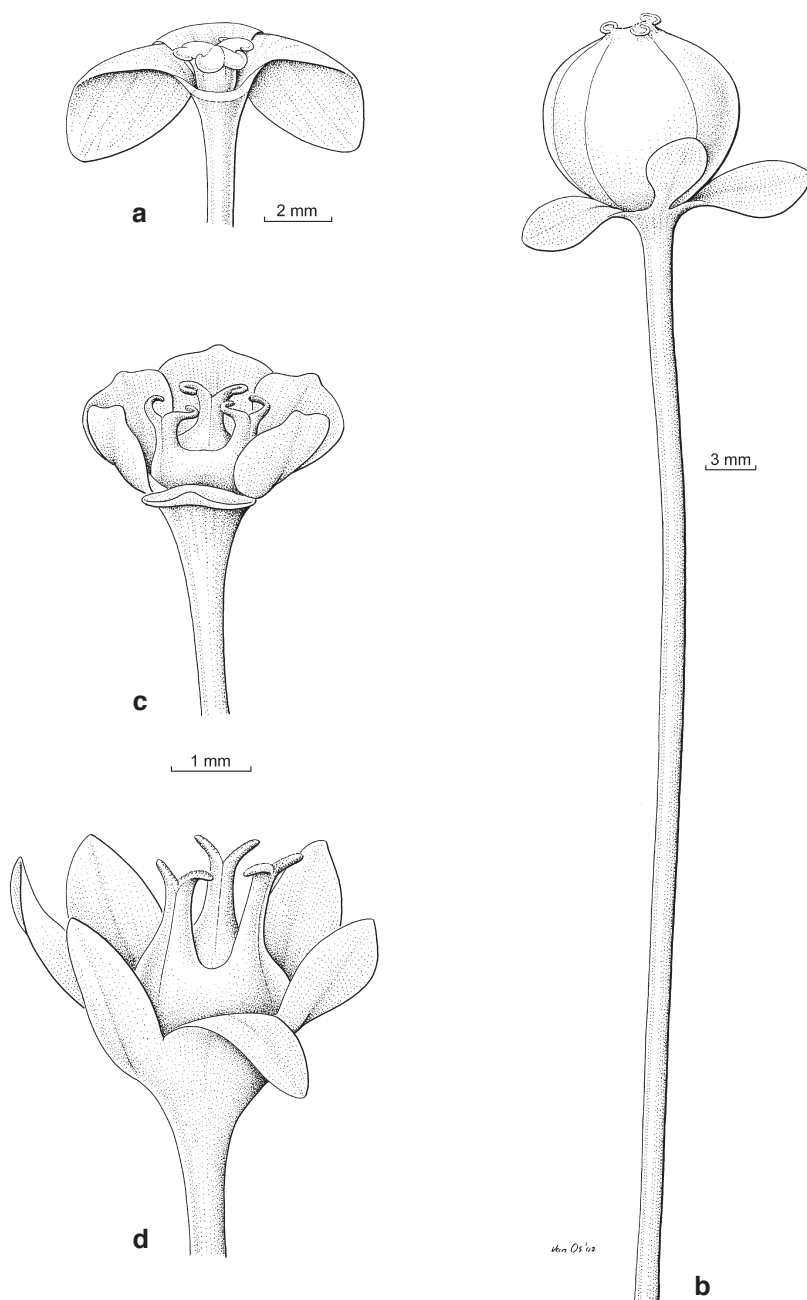


Fig. 3. Different pistillate flowers. — a. *Sauropus rhamnoides* Blume. Common type, horizontal, sessile stigmas, split and curved into crescent moons. — b. *S. macranthus* Hassk. Elongated pedicel. — c. *S. quadrangularis* (Willd.) Müll.Arg. Erect stigmas. — d. *S. granulosus* Airy Shaw. Erect stigmas (a: De Wilde & De Wilde-Duyfjes 13579; b. Van Beusekom & Phengklai 156; c: Geesink, Hattink & Phengklai 7041; d: Maxwell 86-160; all L.).



### Gynoecium

The ovary is 3-locular, stigmas sessile, ovules two per locule, each ovule usually developing into a seed. Three types of ovary are present among the Malesian and Thai species:

- in most species the apex of the ovary is flat(tened) and the stigmas are horizontal, with the unbranched part grown together with the ovary and the split part sticking out and curled, usually for more than 360° (Fig. 3a, b). The stigmas give the impression of three crescent moons, a type of stigma also encountered in many *Phyllanthus* species and in *Breynia retusa* (Dennst.) Alston (but here a style is present);
- in *S. quadrangularis* (Fig. 3c) and the species in the *Hemisauiropus* group (Fig. 3d) the stigmas are erect and split in the upper part. Usually the ovary has fleshy extensions outside the stigmas, creating more or less a cavity in which the stigmas are found; this is also typical for many *Breynia* species;
- in *S. sphenophyllus* the stigmas are erect and not forked, the tips somewhat bend. This is quite typical for *Breynia*.

A special structure, a gynophore, is found in the Indian *Sauropus stipitatus* Hook.f. Because of this structure Pax & Hoffmann (1922) erected the monotypic tribe Sphaeranthi.

### Fruit

Most fruits are normally dehiscent capsules, splitting septically and loculicidally, the fruit thus falling apart in six loose pieces (therefore, the fruit type is termed a rhagma). The wall is smooth, usually glabrous, but sometimes pilose outside, thin and somewhat woody when dry. In some species, e.g., *S. androgynus* and *S. stipitatus*, the dehiscence of the wall is not complete and the fruits open like little 6-pointed stars. In *S. androgynus* and *S. rhamnoides* the fruits are inflated and fleshy when fresh (even edible), papery when dry (Fig. 8d).

The columella is in most species pyramidal and very short. In some species, especially the ones with bigger fruits (e.g., *S. androgynus* and *S. rhamnoides*) or those with fruits higher than broad (e.g., *S. bacciformis*) the stipe is much longer and often remnants of the septa remain (resembling a tennis racket).

### Seeds

The seeds are smooth, and trigonous in transverse section with a convex outer wall and usually a cavity in the ventral (inner) ridge. The cavity is caused by the extremely bullate chalaza which protrudes into the seed (Stuppy, 1995, pers. comm.). According to Stuppy, the seeds are intermediate between a-campylotropous and hemiana-campylotropous (hemiana-campylotropous in *S. bacciformis*). Typical for *Sauropus* and *Breynia* (unique in the Flueggeinae; Stuppy, 1995, pers. comm.) are the partial sarcotesta at the chalazal end (absent in *S. bacciformis* and *S. huntii*), and the spine-like wall formation arising from the inner wall of the inner testa-epidermis cells (present in *S. bacciformis* and *S. huntii*). The sarcotesta is white and spongy in *Sauropus* (pulpy and pale orange in *Breynia*) (Stuppy, 1995, pers. comm.).

## PHYLOGENY

### INTRODUCTION

Several problems exist with and within *Sauropus* with regards to infrageneric groups and the delimitation of *Sauropus*. Infrageneric groups were recognised (see Introduction, and Pax & Hoffmann, 1922; Airy Shaw, 1969), but their circumscription is still not very satisfying (Airy Shaw, 1980b). The inclusion of *Synostemon* in *Sauropus* (Airy Shaw, 1980b) does not really clarify the delimitation of *Sauropus*. Several species of former *Synostemon* can be directed to *Sauropus* (e.g., *S. bacciformis*), while others have a much closer resemblance with *Breynia* and *Glochidion* (e.g., *S. sphenophyllus*). A cladistic analysis seemed the solution to clarify these matters.

Morphological and palynological data were available for the cladistic analysis. Most species of *Sauropus* s.l. (including *Synostemon*) were included in the matrix, together with representatives of *Breynia* (4 spp.), *Glochidion* (5 spp.), *Phyllanthus* (8 spp.), and with *Margaritaria* (1 sp.) as out-group. The characters used, the material used as far as it does not concern the species treated in this revision, and the data matrix are published on website: <http://www.nationaalherbarium.nl/euphorbs/PhylSauT.htm>.

Unfortunately, the analysis on species level failed, after a few days thousands of most parsimonious cladograms (MPCs) were found, of which the resulting strict consensus cladogram comprised mainly gigantic polytomies (for this reason the data are not printed here, but only published on the website). Two main reasons exist for the result:

- *Sauropus* appears to have many characters; however, most of them are autapomorphies. More important, several characters appeared to be parallel autapomorphies (e.g., presence of indumentum, inflorescences, and spicules). If these characters are left out of the analysis, then the remaining characters are inadequate for a sensible analysis;
- the few characters remaining, with those of the other genera added, show more conflict (homoplasy) than support (nested characters).

I wish to discuss the results very briefly, just to indicate some groupings, but the main conclusion is that more data, preferably molecular, are necessary to solve the cladogram of this group of seemingly closely related genera.

The strict consensus cladogram (summarized in Fig. 4) of 21,571 MPCs showed a basal group of some *Phyllanthus* species (those with a single pore per colpus), nested in it the remaining species. Of the latter group, *Glochidion* splits off first in a polytomy with the other species as one of the clades in the polytomy. The latter clade shows a polytomy of a monophyletic *Breynia*, most former *Synostemon* species, and a clade with some *Phyllanthus* species and *Sauropus* s.s. The latter clade breaks into two monophyletic groups, a *Phyllanthus* group (diploporate colpi) and *Sauropus* s.s. *Sauropus* s.s. shows two clades, one the *Hemisauropus* group, with *S. granulosus* Airy Shaw as basally split-off species (palynologically this species is in between *Hemisauropus* and the other *Sauropus* species; Sagun, pers. comm.), and a clade of all other *Sauropus* species with *S. bacciformis*, followed by *S. quadrangularis* as basal species (rest a polytomy). *Sauropus bacciformis* used to be classified in *Synostemon* and

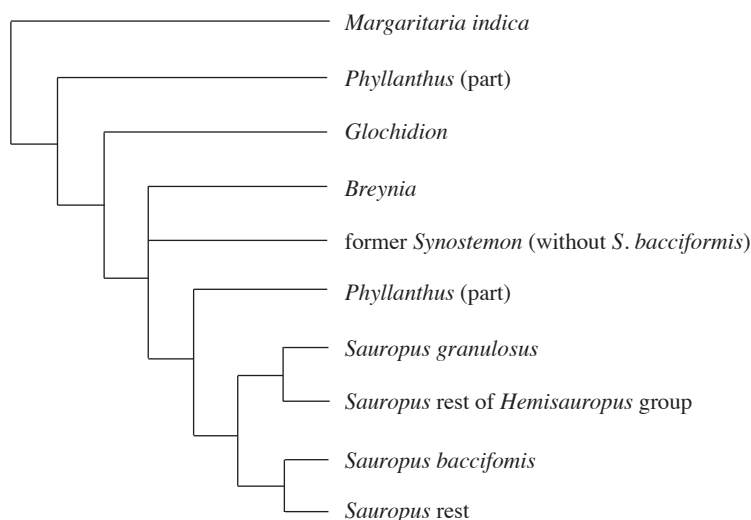


Fig. 4. Summary of the strict consensus cladogram of 21,571 most parsimonious cladograms.

*S. quadrangularis* is intermediate between *Hemisauropus* and the rest of *Sauropus* s.s. because of the vertical stigmas.

Other analyses showed somewhat different results (e.g., *Glochidion* in between *Breynia* and former *Synostemon*), but all agree on the fact that *Breynia*, *Glochidion*, and *Sauropus* s.l. (including *Synostemon*) are nested in *Phyllanthus*.

The species in former *Synostemon* are a heterogeneous group, *S. bacciformis* should be regarded as a proper *Sauropus* species (part of that clade), while the other species included in this analysis were usually grouped with *Breynia* and/or *Glochidion*. I think that *Synostemon* (minus *S. bacciformis*) deserves the status of genus, separate from *Sauropus*. Morphologically it is distinct from *Breynia*, *Glochidion*, and *Sauropus*: staminate flowers with free sepals (calyx in *Breynia* and *Sauropus*), sepals erect (flat in *Sauropus*), calyx scales lacking (present in *Breynia* and *Sauropus* minus *Hemisauropus*), androecium unlike *Sauropus*; pistillate flowers with erect stigmas, which are often not split or only slightly so (different from *Breynia*, *Glochidion*, and most *Sauropus* species).

Within *Sauropus* the *Hemisauropus* group is very distinct (staminate flower: no scales, three calyx lobes inflexed and apex grown with midrib, much larger anthers; pistillate flower: erect stigmas); representatives are: *Sauropus granulosus*, *S. kerrii* Airy Shaw, *S. pierrei*, *S. pulchellus* Airy Shaw, *S. rostratus*, *S. shawii*, and *S. subterblancus*. In some analyses the (Eu)*Sauropus* group was distinct, the species with very large staminate flowers with the calyx lobes almost completely connected; representatives are *S. androgynus*, *S. discocalyx*, *S. garrettii*, and *S. rhamnoides*. All other groups were not distinct at all.

Because of the very unsatisfactory results of the phylogenetic analyses and because some of the infrageneric groups are not recognizable, I will refrain from an infrageneric classification in this revision. Also, I will retain the circumscription of *Sauropus* as Airy Shaw defined it in his last treatment (1980b), including *Synostemon*.

## DISTRIBUTIONS

*Sauropus* ranges from Mauritius and India, throughout Southeast Asia mainland and Malesia to Australia. There are two centres of diversity; one is in Thailand–Indochina (*Sauropus* s.s.), the other in Australia (former *Synostemon*).

*Sauropus* has several very widespread species and many endemic species. This pattern is encountered in many Euphorbiaceae. The most widespread species are *S. androgynus* (Map 3), *S. bacciformis* (Map 5), *S. macranthus* (Map 12), and *S. rhamnoides* (Map 16), they range from India up to East Malesia (and *S. macranthus* even up to Australia).

Thailand has seven endemic species (*S. amabilis* Airy Shaw (Map 1), *S. amoebiflorus* (Map 2), *S. asteranthos* (Map 1), *S. granulosus* (Map 10), *S. kerrii* (Map 10), *S. pulchellus* (Map 10), and *S. poomae* Welzen & Chayamarit (Map 14)), that is 27% endemism (7 out of 26 species). In Malesia the percentage is higher (33%), but the number of species and endemics is lower, 5 out of 15 species: *S. calcareus* in the Malay Peninsula (Map 8), *S. asymmetricus* Welzen on Sumatra (Map 4), *S. micrasterias* Airy Shaw (Map 4) and *S. shawii* (Map 4) on Borneo, and *S. sphenophyllus* on New Guinea (Map 19). Many species have their main distribution in Thailand, but also occur just outside Thailand, e.g., *S. brevipes* (Map 7), *S. discocalyx* (Map 8), and *S. orbicularis* Craib (Map 13).

Only a few species have a very disjunct distribution. *Sauropus villosus* (Blanco) Merr. (Map 21) is the most extreme, present in Thailand, Malay Peninsula, Sumatra, and in the Philippines. *Sauropus rostratus* (Map 17) is very poorly known, a few specimens were found on Sumatra and Borneo and a single specimen in Peninsular Thailand. Within Thailand, *S. asteranthos* (Map 1) and *S. kerrii* (Map 10) show a disjunct distribution, they are present in West Thailand (Chiang Mai to Kanchanaburi Provinces) and in East Thailand (absent in Central Thailand). The distribution of *S. kerrii* is extremely interesting, because the two species to which it is most closely related (*S. granulosus* and *S. pulchellus*) both occur in Central Thailand (Map 10), the area where *S. kerrii* is disjunct.

Several distribution patterns are present. One pattern is shown by *S. androgynus* (Map 3) and *S. rhamnoides* (Map 16); these two closely related species occur in almost exactly the same area. Another pattern might be the disjunct pattern shown by *S. asteranthos* (Map 1) and *S. kerrii* (Map 10). Interesting is that in Thailand quite a few species show their main distribution along the axis Chiang Mai–Kanchanaburi: *S. amoebiflorus* (Map 2), *S. asteranthos* (Map 1), *S. orbicularis* (Map 13), *S. thyrsoflorus* (Map 14); and to a lesser extent: *S. bicolor* Craib (Map 6), *S. brevipes* (Map 7), *S. garrettii* (Map 9), *S. kerrii* (Map 10), and *S. similis* Craib (Map 18). This is of course the best collected part of Thailand.

Interestingly enough, the endemic species in New Guinea, *S. sphenophyllus* (Map 19) is found in the Craton part of New Guinea (Pigram & Davies, 1989), a geologically inactive area and, therefore, very poor in endemic species (Van Welzen, 1997). This is different for the two endemic species in Borneo, *S. micrasterias* (Map 4) is found in the geologically active area near Kuching, and *S. shawii* (Map 4) in the Lahad Datu area of Borneo (Sabah). Both Sarawak and Sabah show more endemic species than expected (Van Welzen, 1992, 1997).

## ECOLOGY

Most *Sauropus* species are (woody) herbs to small shrubs. Only a few species may become treelets (e.g., mainly the more widespread species like *S. macranthus* and *S. rhamnoides*). The majority of the species is found in very variable situations, ranging from waste areas to primary forest. The species are mainly lowland species, though they may occur up to 2100 m altitude. Two species show a very strict adaptation to specialised environments: *Sauropus calcareus* (only on limestone) and *S. heteroblastus* (a rheophyte).

It is surprising that so few species are well-collected. Most plants are small (less than 2 m high) and well visible to collectors. Two probable causes exist. The flowers are small, usually axillary and more or less hidden by the leaves. This is of course not the case with the species with long inflorescences, but these are often cauliflorous near the base of the stem and perhaps invisible against the soil.

## SYSTEMATIC TREATMENT

## SAUROPUS

- Sauropus* Blume (1825) 595; Müll.Arg. (1863) 72; (1866) 239; Hook.f. (1887) 332; Benth. & Hook.f. (1880) 271; Pax & K. Hoffm. (1922) 215; Backer & Bakh.f. (1964) 471; Airy Shaw (1969) 42; (1972) 330; Whitmore (1973) 130; Airy Shaw (1975) 190; (1980a) 199, 221; (1980b) 669; (1981) 342; (1982) 34; (1983) 44; G.L. Webster (1994) 46; Welzen (2000) 57, f. 10; Radcl.-Sm. (2001) 30. — *Sauropus* Blume subg. *Holosauropus* Pax & K. Hoffm. (1922) 216, nom. illeg. — *Sauropus* Blume sect. *Eusauropus* Müll.Arg. (1863) 72; (1866) 240; Hook.f. (1887) 332, nom. illeg. — Lectotype (Webster, 1994): *Sauropus albicans* Blume [= *Sauropus androgynus* (L.) Merr.].
- Ceratogynum* Wight (1852) 26. — Type: *Ceratogynum rhamnoides* Wight [= *Sauropus quadrangularis* (Willd.) Müll.Arg.].
- Diplomorpha* Griff. (1854) 479. — Type: *Diplomorpha herbacea* Griff. [= *Sauropus bacciformis* (L.) Airy Shaw].
- Synostemon* F. Muell. (1858) 32; Backer & Bakh.f. (1964) 470; Airy Shaw (1972) 343; Whitmore (1973) 130; Airy Shaw (1975) 199; L.C. Wheeler (1975) 537; Airy Shaw (1980a) 205. — Lectotype (Wheeler, 1975): *Synostemon ramosissimus* F. Muell. [= *Sauropus ramosissimus* (F. Muell.) Airy Shaw].
- Sauropus* Blume sect. *Cryptogynium* Müll.Arg. (1863) 73; (1866) 243, 'Ceratogynum'; Hook.f. (1887) 334, 'Ceratogynum'; Pax & K. Hoffm. (1922) 222, 'Ceratogynum'; Airy Shaw (1969) 43. — Type: *Sauropus rigidus* Thwaites. (Originally referred to Wight's genus name *Cryptogynum*, but as the oldest available name in its rank is – erroneously – *Cryptogynium*, it must be maintained; see Airy Shaw, 1969).
- Sauropus* Blume sect. *Hemisauropus* Müll.Arg. (1966) 243; Airy Shaw (1969) 55. — *Sauropus* Blume subg. *Hemisauropus* (Müll.Arg.) Pax & K. Hoffm. (1922) 225. — Type: *Sauropus ros-tratus* Miq.
- Aalius* Rumph. [(1743) 207; Lam. (1783) 1] ex Kuntze (1891) 590, nom. superfl. — Lectotype: *Aalius androgynus* (L.) Kuntze [= *Sauropus androgynus* (L.) Merr.]. See chapter 'Nomenclature and species delimitation'.
- Sauropus* Blume sect. *Sphaeranthi* Pax & K. Hoffm. (1922) 220. — Type: *Sauropus stipitatus* Hook.f.
- Sauropus* Blume sect. *Retroversi* Pax & K. Hoffm. (1922) 221. — *Sauropus retroversus* Wight [= *Sauropus androgynus* (L.) Merr.].
- Sauropus* Blume sect. *Schizanthi* Pax & K. Hoffm. (1922) 221. — Lectotype (selected here): *Sauropus trinervius* Wall. ex Müll.Arg.

*Breyniopsis* Beille (1925) 157; (1927) 630. — Type: *Breyniopsis pierrei* Beille [= *Sauropus pierrei* (Beille) G.L. Webster].

*Heterocalymnantha* Domin (1927) 313. — Type: *Heterocalymnantha minutifolia* Domin [= *Sauropus rigens* (F. Muell.) Airy Shaw].

*Sauropus* Blume sect. *Glochidioidei* Airy Shaw (1969) 51. — Type: *Sauropus villosus* (Blanco) Merr.

Herbs to shrubs (to trees), monoecious; stem often with 4 raised ribs. *Indumentum* mainly absent, rarely simple hairs, often asperities present on stem, petioles and/or leaf margins. *Stipules* triangular, late caducous. *Leaves* on branchlets, distichous, simple, symmetric, petiole usually short, base emarginate to acute, margin entire, blade without glands; venation usually indistinct, veins looped and closed near margin. *Inflorescences* ramiflorous or cauliflorous racemes or thyrses to usually axillary fascicles of usually 1 to a few bracteate flowers, all pendent, staminate flowers usually flowering before pistillate ones, staminate ones usually lower on the branches, pistillate ones usually apically. *Flowers* minute, actinomorphic; calyx lobes 6, imbricate; petals absent, disc absent or modified to scales in staminate flowers. *Staminate flowers*: calyx lobes obovoid to obtruncate, minute, three types: 1) apically straight and rounded to deeply incised with erect scale near base, anthers relatively small, horizontal; 2) inflexed, without scales and apex of three sepals grown together with blade, anthers relatively large, obliquely patent; 3) lobes free, without scales, stamens of *Glochidion* type, erect along androphore with triangular extensions on connectives (*S. sphenophyllus*); stamens 3, united, apex of androphore usually split 3 ways, arms horizontally to obliquely patent, anthers underneath, with 4 thecae (except *S. sphenophyllus*); pistillode absent. *Pistillate flowers*: sepals ovate, persistent in fruit; ovary 3-locular, subapically lobed, apex emarginate, crater-like; ovules 2 per locule; style absent; stigmas 3, on wall of crater, completely split to split to halfway (erect and not split in *S. sphenophyllus*), flat and crescent-moon-like in most species. *Fruits* capsular, not lobed, (partly) dehiscent, usually thin-walled and woody when dry to fleshy and inflated in a few species, smooth. *Seeds* triangular in transverse section with sarcotestal tissue near subapical cavity on inner ridge.

Distribution — A genus of 70 or more species, with a single widespread species on Mauritius, all others ranging from India and Sri Lanka to S China, SE Asia (main diversity), Malasia, to Australia (main diversity of what used to be called *Synostemon*). Fourteen species in Malasia. The infrageneric classification, basically by Pax & Hoffmann (1922), is not satisfactory (Airy Shaw, 1980b), therefore, I will refrain from an infrageneric division.

## KEY TO THE THAI SPECIES

(Floristic districts in Thailand, see Flora of Thailand for geographic circumscription: N = Northern, NE = North-eastern, E = Eastern, SW = South-western, C = Central, SE = South-eastern, P = Peninsular.)

- 1a. Plants hairy (though sometimes very sparsely) . . . . . 2  
 b. Plants glabrous (but sometimes with asperities – a kind of papillae) . . . . . 5  
 2a. Branches with two ridges, often flattened. Leaves small, blade 0.6–4.1 by 0.5–1.8  
 cm. Ovary with erect stigmas, in fruit surrounded by a lobed ridge . . . . .  
 . . . . . **21. *S. quadrangularis***



- b. Branches round, without ridges. Leaves larger, blade 1.2–7.5 by 0.7–3.8 cm. Ovary with horizontal stigmas, fruit without an apical ridge around the stigmas . . . . . 3
- 3a. Leaves with convex margins, blade 1–3.8 cm broad, length/width ratio 1.4–2.2. Staminate flowers with distinct calyx lobes. Pistillate flowers with 3 smaller and 3 larger calyx lobes, in fruit up to 5.8 by 3.8 mm and 9.2 by 4.5 mm, respectively . . . . . **14. *S. hirsutus***
- b. Leaves with straight, almost parallel margins, gradually tapering towards each other, blade 0.7–2.2 cm broad, length/width ratio 1.1–3.4. Staminate flowers without distinct calyx lobes. Pistillate flowers with equal lobes, 0.4–1.3 by 0.7–1.2 mm 4
- 4a. Leaf base slightly emarginate, apex rounded. Staminate flowers c. 4 mm diam. on up to 6 mm long pedicels. Pistillate flowers c. 3 mm diam. on up to 4 mm long pedicels . . . . . **1. *S. amabilis***
- b. Leaf base cuneate, apex acute, often mucronulate. Staminate flowers 2.2–3 mm diam. on up to 4 mm long pedicels. Pistillate flowers c. 2 mm diam. on up to 0.7–1(–2.5 in fruit) mm long pedicels . . . . . **32. *S. villosus***
- 5a. Rheophyte with very short lateral shoots (up to 4 mm long) with (1 or) 2 (or 3) leaves . . . . . **13. *S. heteroblastus***
- b. Normal herbs to trees, no rheophytes, lateral shoots much longer (usually more than 10 cm long), with more than 3 leaves per branch . . . . . 6
- 6a. Plants cauliflorous and/or ramiflorous (flowering branches more than 3 mm thick), flowers directly on the stem or on inflorescences of more than 2 cm long . . . 7
- b. Plants with axillary flowers (flowering branches less than 3 mm thick), flowers directly in the axil or on short, usually less than 5 mm long, inflorescences . 12
- 7a. Flowers and fruits on the stem (axils of caducous leaves). Leaves obovate, blade 7.6–13 cm long . . . . . **26. *S. spatulifolius*** (cultivated)
- b. Flowers and fruits in inflorescences. Leaves ovate to elliptic (to obovate: then blade 7.7–24.2 cm long and bark very corky with longitudinal fissures) . . . . 8
- 8a. Inflorescences short, up to 2 cm long, branching. Leaves ovate, blade 2.6–10.1 cm long. . . . . **30. *S. thorelii*** (cultivated)
- b. Inflorescences much longer than 2 cm, up to 7–51 cm long, not branching. Leaves ovate (then blade 3.7–7.3 cm long) to elliptic (then blade up to 26 cm long) . . 9
- 9a. Leaves ovate, base truncate, blade 3.7–7.3 cm long. — Stem apically densely set with broken off stipules and scars of branches . . . . . **19. *S. poomae***
- b. Leaves (ovate to) elliptic (to obovate), base attenuate to cuneate, blade 6.5–26 cm long. . . . . 10
- 10a. Inflorescences up to 7.5 cm long. Staminate flowers 12–13 mm diam. Bark not corky, not fissured. — P. . . . . **10. *S. discocalyx***
- b. Inflorescences 12–51 cm long. Staminate flowers 3.7–7 mm diam. — N, SW; P: bark of older branches with thick fissured cork . . . . . 11
- 11a. Bark of older branches with a thick cork layer (try with finger nail), often with longitudinal fissures. Staminate flowers 3.7–4 mm diam.; pistillate flowers 4.3–7.7 mm diam. — P. . . . . **28. *S. suberosus***
- b. Bark of older branches without thick cork layer. Staminate flowers 6–7 mm diam.; pistillate flowers 11–12 mm diam. — N, SW . . . . . **31. *S. thyrsoflorus***
- 12a. Staminate calyx campanulate, 3 lobes folded inwards and grown together with raised midrib, 3 others apically involute; scales absent. . . . . 13



- b. Staminate calyx flat, lobed or not lobed, lobes not folded inwards, midribs not raised; scales present ..... 17
- 13a. Leaves ovate to elliptic, apex acute. Asperities on young branches absent or present ..... 14
- b. Leaves obovate, apex truncate to round. Asperities on young branches absent. — N, NE, E, SE ..... 15
- 14a. Leaf blades 3.5–7.5 cm long, coriaceous, glaucous when dry ..... **29. *S. subterblancus***
- b. Leaf blades 3.1–3.2 cm long, chartaceous, not glaucous when dry ..... **23. *S. rostratus***
- 15a. Leaf blades 0.5–1.2 by 0.3–0.7 cm, drying dark brown above, smooth ..... **15. *S. kerrii***
- b. Leaf blades 0.7–2.7 by 0.3–1.1 cm, drying greyish greenish (smooth) or light greyish brown above (granular impression above) ..... 16
- 16a. Nerves, also tertiary ones, visible, but not distinctly raised; basal nerve ending just below or above middle, drying light greyish brownish above, giving a granular impression ..... **12. *S. granulatus***
- b. Nerves, also tertiary ones, well-visible and raised; basal nerve ending far below blade middle; drying greenish, smooth ..... **20. *S. pulchellus***
- 17a. (At least some, sometimes 1 or 2) leaf blades longer than 5 cm, ovate (to elliptic), papery (to pergamentaceous). Staminate pedicel (take ripe flowers!) 4.5–15 mm long. Pistillate pedicel (take ripe flowers or fruits!) 3.2–63 mm long. Staminate calyx usually not or hardly lobed (NB: *S. androgynus* keys out in both leads) 18
- b. (All) leaf blades shorter than 5 cm, ovate to obovate, if some leaves longer than 5 cm then: leaves coriaceous (if papery follow other lead). Staminate pedicel 1.7–6.2 mm long. Pistillate pedicel 1.2–4.8 mm long. Staminate calyx usually lobed 21
- 18a. Pistillate pedicel 25–63 mm long. Staminate flowers 3.3–4 mm diam. Leaf blades 8.2–20 cm long ..... **16. *S. macranthus***
- b. Pistillate pedicel 3.2–20 mm long. Staminate flowers 2.5–18.5 mm diam. (if smaller than 4 mm then leaves 1.8–9.1 mm long). Leaf blades 1.8–13 cm long ..... 19
- 19a. Leaves usually gradually tapering into an acute apex. Stigmas forming an incomplete circle. Leaf blades 1.8–9.1 cm long. Fruits fleshy and inflated, 14–16 by 9–15 mm ..... **3. *S. androgynus***
- b. Leaves sinuately (abruptly) tapering into an acuminate apex. Stigmas (full grown flowers!) forming more than a complete circle. Leaf blades 2.2–13 cm long. Fruits not fleshy, not inflated, 7–8 by 9–11 mm or fleshy and inflated, 13–31 by 13–23 mm ..... 20
- 20a. Young branches often with minute asperities between ribs. Petioles on upper surface and basal part of midrib also with minute asperities. Pistillate flowers 4–8 mm diam. Fruits not fleshy, not inflated, 7–8 by 9–11 mm; column absent. Seeds not hollow adaxially. — N, NE ..... **11. *S. garrettii***
- b. Young branches, petioles, and leaves without asperities. Pistillate flowers 6.5–9.5 (–14.5 in fruit) mm diam. Fruits fleshy, inflated, 13–31 by 13–23 mm; column present. Seeds strongly hollow adaxially. — SE, P ..... **22. *S. rhamnoides***

- 21a. Leaves ovate. Stems with 4 raised ribs, always few young branches with asperities on ribs. . . . . **25. *S. similis***
- b. Leaves ovate to elliptic to obovate. Stems with 2 or 4 raised ribs, always all without asperities (but sometimes asperities between ribs or on leaves) . . . . . 22
- 22a. Leaves elliptic, blades 1.9–6 times longer than wide, without asperities, usually drying yellowish. Staminate flowers 1.2–1.5 mm diam. Fruits higher than wide . . . . . **6. *S. bacciformis***
- b. Leaves ovate to elliptic to obovate, blades 1.2–3 times longer than wide (in the narrow-leaved *S. amoebiflorus* leaf margin with asperities), drying brownish to greenish. Staminate flowers more than 2 mm diam. Fruits usually wider than high . . . . . 23
- 23a. Staminate flowers with calyx lobed deeply divided (up to scales), apices acute; sometimes smaller lobes not developed and calyx seemingly triangular and 3-lobed . . . . . 24
- b. Staminate flowers with calyx not lobed or lobes far less divided, apices usually rounded . . . . . 25
- 24a. Leaves (ovate to) elliptic, blade 2.1–5.1 cm long, 1.5–3 times longer than wide, margins with asperities. Staminate flowers 3.5–5.2 mm diam., sometimes smaller lobes not developed and calyx triangular, 3-lobed. Pistillate flowers 6.3–9 mm diam. . . . . **2. *S. amoebiflorus***
- b. Leaves (elliptic to) obovate, blade 2–3.2 cm long, 1.3–2 times longer than wide, margins without asperities. Staminate flowers 2–3.2 mm diam., all lobes developed. Pistillate flowers 3.5–5 mm diam. . . . . **4. *S. asteranthos***
- 25a. Leaves with distinctly raised venation (also tertiary ones) on both sides, usually cells filled with silica visible as dots on top of venation (microscope!) . . . . . **18. *S. orbicularis***
- b. Leaves, certainly on upper surface, with venation not or hardly raised, no silica filled cells visible . . . . . 26
- 26a. Leaves ovate (to elliptic), blade 1.8–9.1 by 0.5–4 cm, papery (6–10 nerves per side) or coriaceous (5–7 nerves per side), margin flat to revolute. Fruits woody when dry or fleshy and inflated, 7–16 by 5.5–15 mm. . . . . 27
- b. Leaves (ovate to) obovate, blade 0.6–4.1 by 0.5–2 cm, papery to chartaceous, nerves 6–8 per side, margin always flat. Fruits woody when dry, 5–5.5 by c. 4 mm . . . . . 28
- 27a. Leaves papery (to pergamentaceous), usually drying greenish; nerves 6–10 per side. Staminate flowers 2.5–18.5 mm diam. Pistillate pedicel 3.2–14 mm long. Fruits fleshy, inflated, 14–16 by 9–15 mm . . . . . **3. *S. androgynus***
- b. Leaves coriaceous, usually drying deep warm brown; nerves 5–7 per side. Staminate flowers 3–4.8 mm diam. Pistillate pedicel 1.2–4.8 mm long. Fruits thin-walled, woody when dry, not inflated, 7–7.5 by 5.5–6 mm . . . **7. *S. bicolor***
- 28a. Plants often smelling of fenugreek (cumarin, maggi) when dry. Staminate calyx lobes not lobed to slightly emarginate. Stigmas horizontal. Usually asperities on young stems between raised ribs (search well!). . . . . **8. *S. brevipes***
- b. Plants never smelling of fenugreek when dry. Staminate calyx lobes apically divided, deep emarginate. Stigmas vertical. Asperities absent on branches . . . . . **21. *S. quadrangularis***

## KEY TO THE MALESIAN SPECIES

(For the Philippines and the Lesser Sunda Islands see next key; Mal. = Peninsular Malaysia, Sum. = Sumatra, Jav. = Java, Bor. = Borneo, Phil. = Philippines, Sul. = Sulawesi, LSI. = Lesser Sunda Islands, Mol. = Moluccas, NG. = New Guinea.)

- 1a. Plants with hairy stems and (partly) leaves . . . . . 2
- b. Plants completely glabrous (except sometimes for the inflorescence) . . . . . 3
- 2a. Leaves round to ovate, blade 1.4–2.8 by 1–2.3 cm, length/width ratio 1.2–1.4, very thin, almost translucent, apex emarginate to subacute, mainly hairy along margin, nerves 6–8 per side, complete venation extremely distinct on both sides. — Mal. . . . . **9. *S. calcareus***
- b. Leaves ovate, blade 1–6.5 by 0.6–1.9, length/width ratio (1.5–)3.4, papery, not translucent, apex acute, completely hairy beneath and often also above, nerves 9–13 per side, venation rather distinct. — Mal., Sum., Phil. . . . . **32. *S. villosus***
- 3a. Inflorescences cauliflorous to axillary, up to 41 cm long . . . . . 4
- b. Inflorescences axillary fascicles (groups of flowers) or racemes less than 2 cm long . . . . . 6
- 4a. Inflorescences up to 14 cm long, glabrous. Older branches without cork. . . . . 5
- b. Inflorescences up to 41 cm long, slightly hairy. Older branches with thick, longitudinally fissured, soft, brown cork. — Mal. . . . . **28. *S. suberosus***
- 5a. Inflorescences up to 7.5 cm long. Staminate flowers 12–13 mm diam.; calyx disc-like, hardly lobed, lobes very broadly triangular, 1–1.5 by c. 4.5 mm. Pistillate flowers c. 11 mm diam.; pedicel c. 13 mm long. — Mal. . . . . **10. *S. discocalyx***
- b. Inflorescences up to 14 cm long. Staminate flowers 5.5–8 mm diam.; calyx deeply lobed, lobes narrowly triangular, c. 3 by 0.9–1 mm. Pistillate flowers c. 4 mm diam.; pedicel c. 2.2 mm long. — Bor. . . . . **17. *S. micrasterias***
- 6a. Staminate flowers at least (1.5–)2 mm diam. (when 1.5 mm diam. then leaves 5–14 cm long). Leaves round to ovate to elliptic to obovate, blade 0.7–20 cm long. Fruits generally broader than high . . . . . 7
- b. Staminate flowers 1.2–1.5 mm diam. Leaves elliptic, blade 0.65–2.5 cm long. Fruits higher than broad. — Mal., Jav., Bor., Phil., LSI. . . . . **6. *S. bacciformis***
- 7a. Staminate flowers with 3 hooded sepals (apex incurved and grown with blade), the other 3 sepals apically incurved. Stamens: anthers almost erect, large: 0.7–1 by 0.8–1.7 mm. Leaves ovate. Stigmas erect, apically split (unknown for *S. shawii*) . . . . . 8
- b. Staminate flowers with flat sepals, apically not incurved to incurved but then not grown with rest of lobe. Stamens either with 3 horizontal branches with anthers underneath (0.2–0.6 by 0.2–0.6 mm) or stamens completely united and erect (c. 0.8 by 0.3 mm, NG.). Leaves round to ovate to obovate. Stigmas erect and not split (NG.) or horizontal and apically split . . . . . 9
- 8a. Leaf blades 2.9–7 by 0.9–2.6 cm, length/width ratio 1.9–3.2, apex gradually acute, midrib sharply raised above, whitish when dry, especially beneath. — Sum., Bor. . . . . **23. *S. rostratus***
- b. Leaf blades 6.8–11.2 by 3.8–4.9 cm, length/width ratio 1.8–2.3, apex acuminate to cuspidate, midrib hardly raised, not differently coloured when dry. — Bor. . . . . **24. *S. shawii***

- 9a. Leaves round to ovate to obovate (on NG.: ovate to elliptic). Stamens not completely united, anthers on three horizontal branches. Stigmas horizontal, split 10  
 b. Leaves obovate. Stamens completely united and erect (*Glochidion*-like). Stigmas erect, apically not split. — NG. . . . . **27. *S. sphenophyllus***
- 10a. Leaves round to ovate to obovate, blade up to 3.3 cm long (*S. calcareus*: leaves extremely thin, venation very distinct). Staminate flowers distinctly lobed, 2–4.2 mm diam. Fruits less than 1 cm broad (*S. brevipes*: young branches with asperities between ribs.) — Mal. . . . . 11  
 b. Leaves ovate (to elliptic), blade 1.8–20 cm long, papery to coriaceous, with at most distinct venation. Staminate flowers (in case of small leaves) not to hardly lobed, 1.5–25 mm diam. Fruits 1.2–3.1 cm broad. Young branches lacking asperities . . . . . 12
- 11a. Leaves (ovate to elliptic to) obovate, base cuneate, not peltate, venation mainly visible beneath. Young branches usually with asperities between ribs . . . . . **8. *S. brevipes***  
 b. Leaves round to ovate, base emarginate to truncate, subpeltate, venation extremely distinct on both sides. Young branches without asperities . . . . . **9. *S. calcareus***
- 12a. Pistillate pedicel 3.2–20 mm long. Stipules 1.8–3.5(–6) by 0.8–1.5(–2.2) mm; when stipules 3–6 mm long then staminate flowers c. 1.5 mm diam., otherwise staminate flowers 2.5–25 mm diam. . . . . 13  
 b. Pistillate pedicel 25–75 mm long. Stipules 2.3–8.5 by 1.3–2.8 mm. Staminate flowers 2.3–4.5 mm diam. — Malesia . . . . . **16. *S. macranthus***
- 13a. Staminate flowers 2.5–25 mm diam. Stipules 1.8–3.5 by 0.8–1.5 mm. Leaves drying (greyish) light greenish beneath, not to hardly papillate beneath, venation distinct on both sides; apex gradually acute or acuminate to cuspidate . . . . . 14  
 b. Staminate flowers c. 1.5 mm diam. Stipules 3–6 by 1–2.2 mm long. Leaves drying greyish green beneath, papillate beneath, venation very indistinct; apex acuminate. — Sum. . . . . **5. *S. asymmetricus***
- 14a. Leaves gradually tapering to acute apex, sinuses below apex absent or indistinct, blade 1.8–9.5 cm long. Staminate flowers 2.5–6(–20 Thailand) mm diam. Pistillate flowers 4–10 mm diam. Fruits 12–17 by 9–14 mm. — Malesia . . . . . **3. *S. androgynus*\***  
 b. Leaves apically with 2 sinuses, apex cuspidate, exceptionally (Phil., LSI.) gradually tapering towards apex; blade 2.2–17.2 cm long. Staminate flowers 4.5–19(–25) mm diam. Pistillate flowers 6.5–27 mm diam. Fruits 13–31 by 13–23 mm. — Malesia (absent in Sul., Mol., NG.) . . . . . **22. *S. rhamnoides*\***

\* These two species are difficult to separate in the Philippines and especially the Lesser Sunda Islands; both species have pistillate flowers with the same diameter (LSI.) and leaves with the same shape, though those of *S. rhamnoides* usually somewhat larger. *Sauropus rhamnoides* has a long and sharp leaf apex, while *S. androgynus* has a much shorter more rounded to acute apex.

#### KEY TO THE SPECIES OF THE PHILIPPINES AND THE LESSER SUNDA ISLANDS

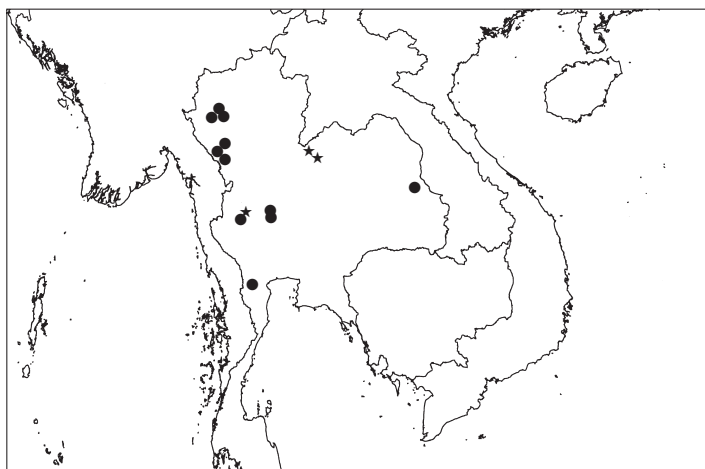
- 1a. Plants completely glabrous (except sometimes for the inflorescence) . . . . . 2  
 b. Plants with hairy stems and (partly) leaves. — Phil. . . . . **32. *S. villosus***
- 2a. Staminate flowers at least 2.5 mm diam. Leaves ovate (to elliptic), blade 2.2–20 cm long. Fruits generally broader than high . . . . . 3

- b. Staminate flowers 1.2–1.5 mm diam. Leaves elliptic, blade 0.65–2.5 cm long. Fruits higher than broad. . . . . **6. *S. bacciformis***
- 3a. Pistillate pedicel 3–27 mm long. Stipules 1.8–3.5 by 0.8–1.5 mm. Staminate flowers 3–25 mm diam. . . . . 4
- b. Pistillate pedicel 25–75 mm long. Stipules 2.3–8.5 by 1.3–2.8 mm. Staminate flowers 2.3–4.5 mm diam. . . . . **16. *S. macranthus***
- 4a. Leaves gradually tapering into a short, obtusely acute apex, blade 1.8–4.6 cm long. Staminate flowers 2.5–4.5 mm diam. Pistillate flowers 4–5.5 mm diam. Fruits c. 15 by 13–15 mm . . . . . **3. *S. androgynus***
- b. Leaves gradually tapering into a long, very sharply acute apex, blade 2.2–11 cm long. Staminate flowers 6.5–12 mm diam. Pistillate flowers 6.5–12 mm diam. Fruits 13–21 by 13–18 mm. . . . . **22. *S. rhamnoideis***

### 1. *Sauropus amabilis* Airy Shaw — Map 1

*Sauropus amabilis* Airy Shaw (1969) 49; (1972) 332; (1974) t. 3709; Smitinand (2001) 466. — Type: *Put 4102* (holo K; iso A, BK, L), Thailand (Siam), Nakhon Sawan (Nakawn Sawan), Hua Wai.

Woody herbs to small shrubs, up to 60 cm tall; branches hirsute, round; flowering branches c. 1 mm thick. *Indumentum* of simple hairs, hirsute, sparse to dense on most parts. *Stipules* triangular, 1.8–2.5 by 0.2–0.5 mm, subhirsute outside, glabrous inside. *Leaves* increasing in size towards the apex of the branches; petiole 1–1.5 mm long, dorsiventrally flattened, hairy; blade ovate with margins tapering towards the apex, 1.3–4.1 by 0.7–2.2 cm, length/width ratio 1.1–3.3, papery, base emarginate, margins flat, apex rounded, slightly hirsute on both sides, glabrescent, papillate beneath; venation slightly raised above, raised below, very distinct on both sides, nerves 8 or 9 per side, veins and veinlets reticulate, more densely so near margin. *Inflorescences* axillary fascicles, flowers usually few (to many) together of same or mixed sexes. *Staminate flowers* c. 4 mm diam., brownish, glabrous except for few hairs on pedicel; pedicel c. 5.9 mm long; calyx not lobed, discoid with inrolled margin, c. 4 mm diam.; stamens:



Map 1. Distribution of *Sauropus amabilis* Airy Shaw (★) and *S. asteranthos* Airy Shaw (●).

androphore c. 0.2 mm high, anthers c. 0.3 by 0.3 mm. *Pistillate flowers* c. 3 mm diam.; pedicel c. 4 mm long, hairy; calyx with ovate lobes, latter c. 1.3 by 1 mm, hairy outside, glabrous except for the margin inside; ovary c. 1 by 0.8 mm; stigmas c. 1 mm long, horizontal, upper 0.5 mm free, forming half circle. *Fruits* unknown.

**Distribution** — Endemic in Thailand (Northern and North-eastern floristic districts).

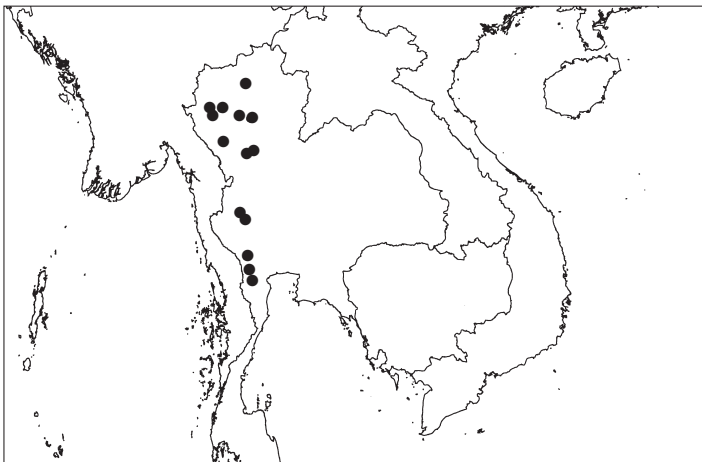
**Habitat & Ecology** — Mixed deciduous forest. Altitude 200–790 m. Flowering: August.

**Vernacular names** — Thailand: Tai bai yai.

## 2. *Sauropus amoebiflorus* Airy Shaw — Fig. 2c; Map 2

*Sauropus amoebiflorus* Airy Shaw (1969) 45; (1972) 332; Smitinand (2001) 466. — Type: *Kerr* 9023 (holo K; iso BM, L), Thailand (Siam), South-western, Ratchaburi Prov., Ratchaburi (Ratburi).

Small woody herbs to shrubs; rootstock woody; branches green, with 4 lighter green ribs, flowering branches c. 1.5 mm thick. *Indumentum* absent. *Stipules* triangular to basally oblique to falcate, 0.8–5.5 by 0.3–3 mm, membranous (to chartaceous), rather persistent, margin with asperities. *Leaves*: petiole 1–1.2 mm long, pulvinate, flattened above except for the raised midrib, with small asperities; blade (ovate to) elliptic, 2.1–5.1 by 0.7–1.6 cm, length/width ratio 1.5–3, pergamentaceous, base cuneate, margin reflexed with small asperities, apex rounded to acute, mucronulate, upper surface dark green, midrib often with asperities, lower surface not (to very slightly) papillate, light green; nerves distinct, 6–9 per side, veins somewhat distinct, laxly reticulate. *Inflorescences* axillary fascicles, flowers single or few together. *Staminate flowers* 3.5–5.2 mm diam., often triangular (then 3 calyx lobes underdeveloped); pedicel 2.7–4 mm long; calyx lobes dimorph, 3 small, not developed or up to 0.8 by 2.5 mm, larger ones up to 2.1 by 2.3 mm, lobes about as long as cup, not reaching scales, apex split up to halfway the lobes, apices acute; stamens: androphore 0.1–0.3 mm long, tan, anthers 0.3–0.4 by 0.3–0.5 mm, light brown. *Pistillate flowers* 6.3–12 mm diam.; pedicel 2–3.2 mm



Map 2. Distribution of *Sauropus amoebiflorus* Airy Shaw.

long; calyx lobes ovate, 3 smaller, c. 3.2 by 3.8 mm, larger ones 2.3–4.5 by 2.3–5 mm, green outside to maroonish inside; ovary obpyramidal, 0.7–1.1 by 1.7–2 mm, light green, stigmas usually horizontal, up to 1 mm long, split up to ovary, in  $\pm$  full circle. *Fruits* ovoid, c. 8 by 5 mm, cream, wider than high; column not seen. *Seeds* triangular in section, c. 4.5 by 3 by 3.5 mm.

Distribution — Endemic in Thailand (Northern and South-western floristic districts).

Habitat & Ecology — Usually found in very secondary evergreen forest, dry dip-terocarp forest, open, dry (scrub) deciduous forest, bamboo forest, open rocky slopes along highway; soil: rocky; granite to limestone to shale bedrock. Altitude 50–800 (–1800) m. Flowering: April to August; fruiting: June.

Vernacular names — Thailand: Kwang he pia, phak wan ban, tai bai (official Thai name).

Notes — 1. In the northern provinces (Chiang Mai, Lamphun, etc.) the leaves are longer and the calyx of the staminate flowers becomes triangular due to three undeveloped smaller calyx lobes. The leaves are shorter and broader in the South-western area, where the staminate calyx has 6 distinct lobes, though three are somewhat smaller.

2. *Sauropus amoebiflorus* strongly resembles *S. bacciformis*. The latter species has leaves which usually dry with a lighter colour, more yellowish, and which lack the asperities; also the staminate and pistillate flowers are much smaller, and the fruits are higher than broad (broader than high fruits in *S. amoebiflorus*).

### 3. *Sauropus androgynus* (L.) Merr. — Fig. 1a; Map 3

*Sauropus androgynus* (L.) Merr. (1903) 30; (1917b) 92; Pax & K. Hoffm. (1922) 217; Merr. (1923) 405; Gamble (1925) 1303; S. Moore (1925) 93; Beille (1927) 645; Backer & Bakh.f. (1964) 471; Airy Shaw (1972) 333; Whitmore (1973) 130; Airy Shaw (1975) 193; (1980a) 199; (1981) 342; (1982) 34; (1983) 44; I. Polunin (1987) 150, f. 153; (1988) 138, f. 138; Levang & Foresta (1991) 66; Du Puy & I. Telford (1993) 263; I.M. Turner (1993) 87; Kapil & A.K. Bhatn. (1994) 145; M.H. Bergh (1994) 244; Wightman, Astuti & Munawaroh (1994) 15; Chakrab. & M.G. Gangop. (1996) 519, f. 1g–j; C.Q. Lin et al. (1999) 255, 256; Philcox (1999) 102; Hung et al. (2000) 197; Smitinand (2001) 466. — *Clusia androgyna* L. (1767) 128. — *Aalius androgynus* (L.) Kuntze (1891) 591, '*androgyna*'. — Lectotype (suggested here): *Hb. Linnaeus 1206.14* (holo LINN).

*Sauropus albicans* Blume (1825) 596; Hassk. (1855) 162; Müll.Arg. (1866) 240; Kurz (1877) 349; Hook.f. (1887) 332; Ridl. (1911) 176; Craib (Dec. 1911) 457; Ridl. (1924) 220. — *Sauropus albicans* Blume var. *genuinus* Müll.Arg. (1866) 241, nom. inval. — Lectotype (proposed here): *Blume s.n.* (holo L, barcode L0138130), Indonesia, Java, Bantam.

*Phyllanthus strictus* Roxb. (1832) 670. — Syntypes: Roxburgh Icones pl. 1685 (K); *Roxburgh s.n.* (Hb. Forsyth) (K), India; *Wallich 7933A* (K-W), *Wallich 7933B* (G-DC, K-W, K); *Wallich 7933E* (K-W, K), India, Sillet.

*Sauropus retroversus* Wight (1853) t. 1951 (left); Thwaites (1864) 284; Müll.Arg. (1866) 241; Hook.f. (1887) 333; Pax & K. Hoffm. (1922) 221; Beille (1927) 651; Chakrab. & M.G. Gangop. (1996) 537, f. 9e–h; Philcox (1999) 104. — *Aalius retroversus* (Wight) Kuntze (1891) 591, '*retroversa*'. — Syntypes: *Anonymous s.n.* (K), Sri Lanka; *Thwaites CP 3134* (G-DC, K), Sri Lanka, Central Prov., Odoopussalawa (Thwaites, 1864); *Walker 274* (K), Sri Lanka.

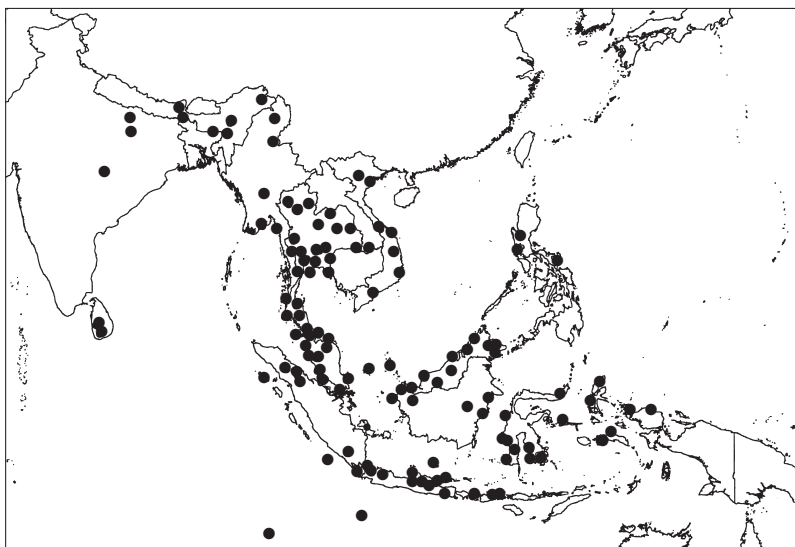
*Sauropus gardnerianus* Wight (1853) t. 1951 (right); Thwaites (1864) 284. — *Sauropus albicans* Blume var. *gardnerianus* (Wight) Müll.Arg. (1863) 72; (1866) 241. — Type: *Gardner 472* (n.v.), Sri Lanka (Ceylon), Hantane.



- Sauropus zeylanicus* Wight (1853) t. 1952 (left). — *Sauropus albicans* Blume var. *zeylanicus* (Wight) Müll.Arg. (1866) 241. — Type: *R. Wight s.n.* (n.v.), Sri Lanka (Ceylon). (A possible syntype, Gardner s.n. in K).
- Sauropus indicus* Wight (1853) t. 1952 (right); Hassk. (1855) 164; Miq. (1859) 366. — Type: *Wight s.n.* (n.v.), India, Courtallum and Shevagherry Hills.
- Agyneia ovata* Miq. (1859) 367. — Type: *Zollinger s.n.* (holo U, barcode U0002081), Indonesia, Java.
- Sauropus sumatranus* Miq. (1860) 179, 446; Ridl. (1924) 220. — *Aalius sumatranus* (Miq.) Kuntze (1891) 591, 'sumatrana'. — Type: *Teijsmann s.n.* (holo U, barcode U0002082; iso A, G-DC), Indonesia, Sumatra, Rau Distr. (= Riau Prov.).
- Sauropus albicans* Blume var. *intermedius* Müll.Arg. (1863) 72; (1866) 241. — Type: *Wallich 273?* (holo G-DC n.v.; IDC microfiche DC herbarium 2461-5), India, Prome.
- Sauropus oblongifolius* Hook.f. (1887) 333. — Syntypes: *Griffith KD 4824* (K), India, East Bengal, Mishmee; *Masters s.n.* (n.v.), India, Upper Assam, Dailoon in the Mishmi Hills.
- Andrachne* spec.: Merr. (1906) 74. — *Sauropus scandens* C.B. Rob. (1909) 72; Pax & K. Hoffm. (1922) 224; Merr. (1923) 405; Airy Shaw (1983) 44. — Type: *FB (Borden) 1934* (holo PNH<sup>+</sup>; iso K, NY, US), Philippines, Luzon, Bataan Prov., Mt Mariveles, Lamao River.
- Sauropus parviflorus* Pax & K. Hoffm. (1922) 218; Beille (1927) 646. — Type: *Warburg 5057* (holo B<sup>+</sup>), Thailand (Siam), Bangkok.
- Sauropus macranthus* auct. non Hassk.: Fern.-Vill. (1883) 187 (pro *Vidal s.n.*, Philippines, Luzon, Tayabas).
- Sauropus* spec., ? aff. *S. stipitato* Hook.f.: Airy Shaw (1972) 339, p.p. [pro *Kerr 8522* (BK, K), Thailand (Siam), Nong Kai (Nawng Kai), Chaiyaburi]. See note 3.

Herbs to shrubs (to treelets), up to 4 m high, dbh up to 3 cm; young branches with 2 or 4 ribs, green, flowering branches 1–2 mm thick. *Indumentum* absent. *Bark* light brown to grey. *Stipules* triangular, 1.8–3.2 by 0.8–1.3 mm, basally somewhat eared, usually thin, usually caducous. *Leaves*: petiole 2–3 mm long, flattened above; blade ovate (to elliptic), 1.8–9.5 by 0.6–4 cm, length/width ratio 1.5–3.8, papery (to pergamentaceous), base rounded to truncate, margin flat to recurved, apex (round to bluntly) acute, at most with slight sinuses below the apex, often mucronulate, dark green above, (grey-)light green and often somewhat papillate underneath; nerves 6–10 per side, usually distinct on both sides, veins somewhat scalariform, veinlets reticulate. *Inflorescences* axillary fascicles (or flowers in up to 8 mm long racemes), flowers single or few together, usually all of same sex. *Staminate flowers* 2.5–6(–20) mm diam.; pedicel 4.5–13 mm long, green; calyx flat, (small and somewhat lobed to) wide, reflexed and hardly lobed, light yellowish green to maroon outside, maroon inside, lobes indistinct to ovate, 0.7–3 by 1.3–5 mm; stamens: androphore 0.1–0.3 mm long, cream, anthers 0.4–0.6 by 0.4–0.6 mm. *Pistillate flowers* 4.5–10 mm diam.; pedicel up to 3.2–11(–14 in fruit) mm long, apically up to 1 mm thick, green; calyx lobes usually obovate, green with maroon to maroon outside, dark maroon inside, smaller ones 1.8–3.5(–4 in fruit) by 1.8–3.8(–5.5 in fruit) mm, larger ones 2.2–5.5 by 2–7 mm; ovary 1.1–1.5 by 1–2 mm; stigmas up to 1.2 mm long, light yellow (with maroon), horizontal, split till halfway, bend, forming less than a circle. *Fruits* globose (to obovoid), inflated, somewhat fleshy but pergamentaceous when dry, 12–17 by 9–15 mm, white to finally maroon; column 8–10 mm long with apically heart-shaped remnants of the septae. *Seeds* triangular in transverse section, hollow adaxially, 7–10 by 4.5–6.5 by 3–4.5 mm, white to black.

Distribution — India, Sri Lanka, Bangladesh?, Myanmar, Laos, Cambodia, Vietnam, Thailand, Peninsular Malaysia, Singapore, Sumatra, Java, Cocos Islands, Christmas Island (Indian Ocean), Borneo, Philippines, Sulawesi, Lesser Sunda Islands, Moluccas, New Guinea (Irian Jaya).



Map 3. Distribution of *Sauropus androgynus* (L.) Merr.

**Habitat & Ecology** — Monsoon (deciduous) forest, secondary forest, swamp forest, open areas and clearings, in scrubs and thickets, waste grounds, hedges, fruit gardens, gardens and house yards, along forest edges, rivers and roads, near the beach, often a weed or cultivated; soil dry to wet, shale, (coral) limestone, sand, weathered phyllite, andesite, sandy loam, granite. Altitude 0–1500 m. Flowering and fruiting throughout the year, though less fruiting from January to March.

**Vernacular names** — Myanmar: Yaung-mapywet; yo-ma-hin-yo (Kurz, 1877). Laos: Pahk wan. Thailand: Cha phak wan, kan tong, ma yom pa, phak kan thong, phak wan, phak wan ban (official Thai name), phak wan tai bai; tho-lui-ka-ne-doh (Karen); nana siam (Malay). Vietnam: Bu lot, cây bu ngot, cây chum ngot, cây cu de, cây dau ngot, cu ve, dom nghob, ran n'got (Beille, 1927). Peninsular Malaysia: Assin-assin, chekop, chekop manis, chekor manis, kasim, kencur manis; thavasi murunggai (Tamil) (partly after Ridley, 1924). Indonesia: cekop manis, katu, katuk, memata (Levang & De Foresta, 1991). Sumatra: Bait memata oetan, daun katu, lakioi, nasi-nasi, simanie, si topoe manok; katoe (Akar, Malay). Java: Boemo, kera kuhr, katoek/katuk; babing, katukan, katu (Javanese; Levang & De Foresta, 1991); daun katuk, katuk (Sundanese; Levang & De Foresta, 1991), katuk utan (Sundanese, Djasilin dialect). Borneo: Kalimantan Timur: Daun katuk; Sabah: Chang kok manis (Malay); sayor manis (Dusun). Philippines: Tawitawi (Basilan Island). Moluccas: Katoek.

**Uses** — Young shoots, leaves, but also flowers and fruits are eaten, raw, cooked or in the soup, as a vegetable throughout the region. They taste sweet and have a nice or very typical odour. The plant is often cultivated in small fields, as hedges, or allowed as weed near the house. Stripped leaves and young shoots are sold in the market. Dried and crushed root is used medicinally in Chiang Mai (Thailand) against headache, but seemingly also acts against fever or urinary problems; the leaves are thought to

stimulate milk production and recover the womb after child birth. In Java the leaves are also used to treat wounds and against colds (*Harini* 35). Used as a green dye in food products. (Partly after Van den Bergh, 1994). According to Levang & De Foresta (1991) the plant is used as a vegetable, fruit, medicinally, as dye, and ornamentally.

Chemical compounds — Lin et al. (1999) report that the major chemical essential oil constituents of the leaves are: Carvacrol methyl ether (49.35%), thymol (14.67%) and butylated hydroxytoluene (10.5%); all other oil compounds are usually less than 2%. The plant is exceptionally rich in several vitamins and contains the alkaloid papaverine in harmless quantities (Polunin, 1987, 1988). Hung et al. (2000) relate that in Taiwan *S. androgynus* is used to slim down and when the amounts of papaverine become too high, consumption of *S. androgynus* causes Bronchiolitis Obliterans (a fibrosing process of the lungs).

Notes — 1. *Sauropus androgynus* is a widespread, often cultivated species, and, probably therefore, very variable. Usually the leaves are rather small, less than 5 cm long, but many exceptions exist; the apex usually gradually narrows into an acute acuminate, the staminate flowers are usually hardly lobed (though often somewhat lobed in N Thailand and Laos, and exceptionally in other areas), the pistillate sepals are somewhat dimorph, and the fruits are inflated and somewhat fleshy.

2. This species is difficult to distinguish from *S. garrettii* (see note under latter), *S. macranthus*, and *S. rhamnoides*. All three species usually have acuminate leaves with very distinct sinuses near the apex, while *S. androgynus* has acute leaves, gradually narrowing towards the apex without distinct sinuses. However, *S. androgynus* may have slight sinuses and *S. garrettii* and Philippine *S. rhamnoides* may almost lack the sinuses. *Sauropus macranthus* has larger leaves, longer and more persistent stipules, and different staminate flowers. Compared with *S. androgynus*, *S. rhamnoides* usually has (much) larger leaves (big overlap), wider staminate flowers (overlap, especially due to some exceptional specimens of *A. androgynus* in Thailand and Borneo), pistillate sepals usually larger and distinctly dimorph, and larger fruits.

3. *Sauropus* spec. (Airy Shaw, 1972) is referred to *S. androgynus*, because staminate flowers with distinct, incurved lobes are often encountered.

#### 4. *Sauropus asteranthos* Airy Shaw — Map 1

*Sauropus asteranthos* Airy Shaw (1969) 47; (1972) 333; Smitinand (2001) 467. — Type: *Kerr 21530* (holo K; iso BM, L), Thailand (Siam), North-eastern (Udon Thani Circle), Nakhom Phanom Prov., Dawn Tan.

Woody herbs, up to 1 m high; young branches with 2 ribs, older ones faintly 4-ribbed, often maroonish, flowering branches 0.5–0.8 mm thick, chartaceous, rather persistent. *Indumentum* absent. *Stipules* triangular on young branches, larger and falcate on older ones, 0.7–3 by 0.3–2 mm. *Leaves*: petiole 1–1.2 mm long, pulvinate; blade (elliptic to) obovate, 0.8–2.5 by 0.4–2 cm, length/width ratio 1.3–2, papery, base slightly oblique to truncate to cuneate, margin flat to revolute, apex round to acute, mucronulate, upper surface dark green, usually (at least several) with white dots, lower surface papillate, pale light green; nerves rather distinct, 3–6 per side, veins only somewhat distinct below, reticulate. *Inflorescences* axillary fascicles, flowers single or few together of both sexes, (light yellow or light green to) deep maroon. *Staminate flowers* 1.5–3.2

mm diam.; pedicel 1.7–4 mm long; calyx lobes 0.5–1.1 by 0.6–1.1 mm, lobed up to scales, apices acute, bifid till halfway lobes, scales as broad or slightly broader than lobes, quite high, thick; stamens: androphore c. 0.2 mm high, anthers c. 0.2 by 0.2 mm, brownish. *Pistillate flowers* 3.5–5 mm diam.; pedicel 1.2–2 mm long; calyx lobes spade-like, smaller ones 1.2–2 by 1.3–2.6 mm, larger ones 1.8–2 by 1.4–3 mm; ovary obpyramidal, 0.7–1.6 by 1.2–1.7 mm; stigmas horizontal, up to 1 mm long, split till halfway, curled into a full circle. *Fruits* subglobose, c. 4.5 by 4 mm, with a small apical rim around persistent stigmas; column c. 2.8 mm long, tapering towards apex. *Seeds* triangular in section, c. 3.8 by 2 by 2 mm.

Distribution — Endemic in Thailand (Northern, North-eastern, and South-western floristic districts).

Habitat & Ecology — Open places in dry deciduous dipterocarp(-oak) forest, scrub jungle, and along roads in secondary forest; soil: granite bedrock. Altitude 100–800 m. Flowering: April to October.

Vernacular names — Thailand: Mayom don (official Thai name); yah-hoon-hai (Lao).

Note — Very similar to *S. quadrangularis*, mainly differing in the more deeply lobed and sharply pointed calyx lobes of the staminate flowers and in the flat instead of erect stigmas. Moreover, most leaves of *S. asteranthos* show white dots above, these are (usually) absent in *S. quadrangularis*.

## 5. *Sauropus asymmetricus* Welzen, *spec. nov.* — Map 4

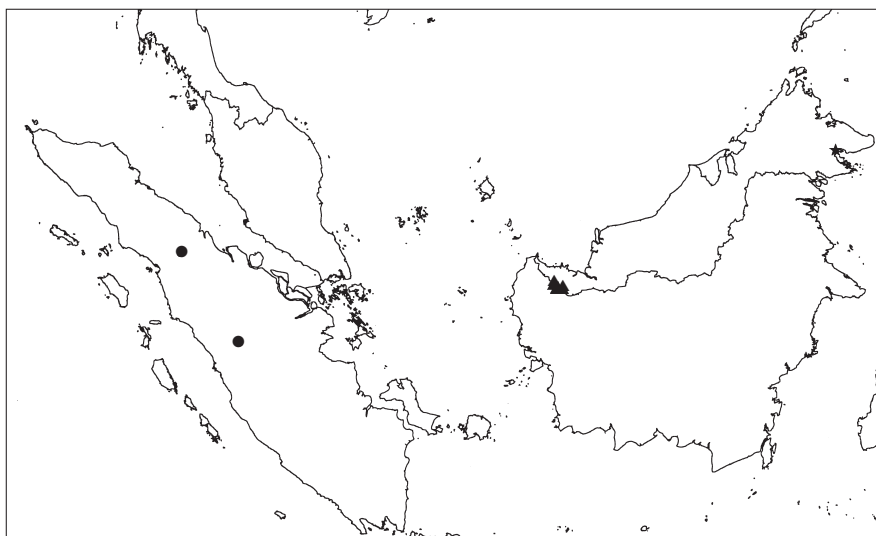
Folia basi asymmetrica rotundata ad late cuneata, infra cinereo-viridia in sicco. Flores staminati c. 1.5 mm in diam., lobis calycis inflexis apice libero, lobi tres apice acuto, tres ceteri apice rotundato. Fructus 16–19 mm longi 15–17 mm lati. — Typus: *Yates 1241* (holo BM, barcode BM000606476), Indonesia, Sumatra.

Small shrub; young branches with 2 faint ribs, flowering branches 1.5–2.5 mm thick. *Indumentum* absent. *Stipules* triangular, 3–6 by 1–2.2 mm, basally eared, rather stiff and persistent. *Leaves*: petiole c. 4 mm long, above channelled; blade ovate, 5.1–13.5 by 3.6–5.2 cm, length/width ratio 1.4–2.6, papery, base asymmetric, rounded to very broadly cuneate, margin flat, apex acuminate, mucronulate, upper surface drying dark green, lower surface drying greyish green, densely papillate; venation indistinct on both sides, hardly raised beneath, nerves 8–10 per side, veins and veinlets indistinct. *Inflorescences* axillary fascicles (to short racemes of less than 1 cm long), flowers single or few staminate ones together. *Staminate flowers* c. 1.5 mm diam.; pedicel c. 2.5 mm long; calyx c. 1.2 mm high, smaller lobes c. 0.8 by 0.6 mm, apex incurved, acute, larger lobes c. 0.8 by 0.7 mm, apex further incurved, rounded; stamens: androphore 0.3–0.4 mm long, anthers c. 0.3 by 0.5 mm. *Pistillate flowers* unknown; fruiting pedicel c. 10 mm long; calyx lobes c. 1.5 by 1.2 mm. *Fruits* subglobose, 16–19 by 16–17 mm, wall rather thin, somewhat corky, apically with small hole between stigmas; column not seen. *Seeds* triangular in cross section, c. 13 by 6 by 6 mm.

Distribution — Sumatra.

Habitat & Ecology — Primary hill forest and secondary forest; soil: limestone, 'red' soil. Altitude 500 m. Flowering: December; fruiting: October to May.

Vernacular names — Sumatra: Kajoe ira.



Map 4. Distribution of *Sauropus asymmetricus* Welzen (●), *S. micrasterias* Airy Shaw (▲), and *S. shawii* Welzen (★).

Note — This species resembles *S. shawii* from Borneo and at first sight seems to be part also of the *Hemisauiropus* group, because the staminate calyx lobes are inflexed. However, the apices of three staminate calyx lobes are not grown with the blade as in the *Hemisauiropus* group, nor are the anthers large and more or less erect as in the *Hemisauiropus* group, the stamens show the usual *Sauropus* type with horizontal branches with underneath the anthers. The leaves also have a somewhat different shape like those of *S. shawii*, both are basally asymmetric, but the leaf base of *S. asymmetricus* is much wider and the leaves are generally somewhat larger.

## 6. *Sauropus bacciformis* (L.) Airy Shaw — Map 5

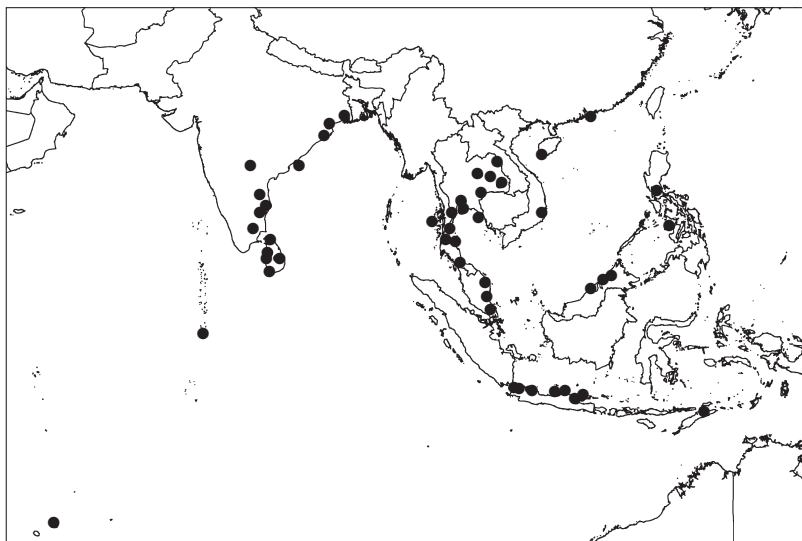
*Sauropus bacciformis* (L.) Airy Shaw (1980a) 221; (1980b) 685; (1981) 343; (1982) 34; Chakrab. & M.G. Gangop. (1996) 523, f. 1a–f; Philcox (1999) 100; Smitinand (2001) 467. — *Phyllanthus bacciformis* L. (1767) 294. — *Agyneia bacciformis* (L.) A. Juss. (1824) 24, t. 6.; Blume (1825) 595; Müll.Arg. (1866) 238; Hook.f. (1887) 285; Pax & K. Hoffm. (1922) 213; Beille (1927) 642, f. 76; Merr. & Chun (1940) 91; Steenis (1948) 410. — *Agyneia phyllanthoides* Spreng. (1826) 19, nom. illeg. — *Diplomorpha bacciformis* (L.) Kuntze (1891) 603. — *Synostemon bacciformis* (L.) G.L. Webster (1960) 26, in adnot.; Backer & Bakh.f. (1964) 471; Airy Shaw (1972) 343; Whitmore (1973) 133; Airy Shaw (1975) 199. — Type: *Koenig s.n.* (n.v.), S India, Tranquebaria.  
*Phyllanthus racemosus* L.f. (1781) 415. — *Emblica racemosa* (L.f.) Spreng. (1826) 20. — Type: *Koenig s.n.* (n.v.), Sri Lanka (Ceylon).  
*Agyneia impubes* Vent. (1800) 23, t. 23. — Type: *Bojer s.n.* (K), Mauritius.  
*Diplomorpha herbacea* Griff. (1854) 479. — Type: Not indicated (n.v.), India.  
*Phyllanthus goniocladus* Merr. & Chun (1935) 260, t. 51. — Type: *F.C. How 70913* (holo NY; iso A), China, Hainan, Yaichow (Ngai Yuen).  
*Sauropus gramineus* Airy Shaw (1980b) 389. — Type: *Kerr 8472* (holo K; iso BM), Thailand (Siam), North-eastern (Udawn Circle), Nakhon Phanom Prov. (Nakawn Panom), Ta Uten. — See note 1.

Herbs to subshrubs up to 50 cm high, pale green, branches with mainly 4 ribs, flowering branches c. 1.5 mm thick. *Indumentum* absent. *Stipules* triangular to falcate, 1.7–3 by 0.5–1.5 mm, papery, rather persistent, often with very small asperities along margin and midrib beneath. *Leaves*: petiole less than 1 mm long, flattened above; blade elliptic, 6.5–25 by 1.5–7(–13) mm, length/width ratio 1.5–7.8, pergamentaceous (fleshy when fresh), base rounded, margin flat, without asperities, apex rounded to acute, lower surface somewhat papillate and glaucous; nerves very indistinct, only midrib distinct beneath. *Inflorescences* axillary fascicles; flowers green to light purple, several together (staminate) or single (pistillate), pistillate flowers at end of branches. *Staminate flowers* 1.2–1.5 mm diam.; pedicel c. 0.6 mm long; calyx lobes deeply divided, ovate, 0.4–0.6 by 0.3–0.4 mm, apex entire, rounded, scales subapically on inside; stamens: androphore c. 0.2 mm high; anthers c. 0.2 by 0.2–0.3 mm. *Pistillate flowers* 3–5.5 mm diam.; pedicel 3–4 mm long; sepals free, ovate, 2–2.8 by 1–1.4 mm, apex acute, reflexed in fruit; ovary obtruncate, 1–1.3 by 0.9–1 mm, apically with fleshy extensions basally to styles; styles c. 0.5 mm long, erect, upper half split, hardly coiled. *Fruits* ovoid, 5–5.2 by 5.5–6.5 mm, green, with apically a lobed rim around stigmas; column 3.2–3.3 mm long, with ellipsoid thickening above middle to apex. *Seeds* triangular in section, 4.5–4.9 by 1.2–1.8 by 1.2–1.5 mm, surface strobiculate.

**Distribution** — Mauritius, Maldives, India, Sri Lanka, S China, SE Asia mainland, West Malasia: Malay Peninsula, Java, Borneo, Philippines, Lesser Sunda Islands (Timor).

**Habitat & Ecology** — Especially along or near beaches, usually in sun, also recorded to be common in wet, grassy roadsides, edges of rice fields, along path through mangrove, tidal flats and in open waste grounds; soil: usually silty sand, clay, limestone. Altitude: sea level up to 200(–1800) m. Flowering and fruiting throughout the year.

**Vernacular names** — Thailand: Ma pharo nok khao, soi nok khao (official Thai name), thong laeng.



Map 5. Distribution of *Sauropus bacciformis* (L.) Airy Shaw.



Notes — 1. Airy Shaw (1980b) states that, even though the habit and leaves of *S. gramineus* resemble those of *S. bacciformis*, the staminate flowers are like those of *S. quadrangularis*. However, a study of the type showed a perfect match of the staminate flowers with those of *S. bacciformis*. Therefore, the name *S. gramineus* is synonymized with *S. bacciformis*.

2. See second note under *S. amoebiflorus*.

## 7. *Sauropus bicolor* Craib — Fig. 2a, 5; Map 6

*Sauropus bicolor* Craib (1914a) 11; Pax & K. Hoffm. (1922) 223; Beille (1927) 654; Airy Shaw (1972) 333; Chakrab. & M.G. Gangop. (1996) 523, f. 5f, g; Smitinand (2001) 467. — *Sauropus rigidus* Craib (1911) 457, nom. inval., non Thwaites (1864). — *Sauropus bicolor* Craib var. *bicolor* Airy Shaw (1972) 333. — Lectotype (selected here): *Kerr 651* (holo K; iso BM, K), Thailand (Siam), Chiang Mai Prov., Doi Sutep.

*Phyllanthus* spec.: Hosseus (1911a) 373. — *Phyllanthus parvifolius* auct. non Buch.-Ham ex D. Don: Hosseus (1911b) 407. — *Sauropus similis* Craib var. *microphylla* Craib (1912) 184. — *Sauropus bicolor* Craib var. *microphyllus* (Craib) Airy Shaw (1972) 333. — Type: *Hosseus 48* (holo K), Thailand (Siam), Wang Djao.

Woody herbs to small shrubs (to trees), up to 1(–8) m high, with woody rootstock, young branches with 2 or 4 shallow ribs, green, flowering branches 1–1.4 mm thick. *Indumentum* absent. *Stipules* triangular, 1.2–2.6 by 0.9–1.6 mm, often eared basally, chartaceous, rather persistent. *Leaves*: petiole 1.5–2 mm long, pulvinate; blade ovate (to per plant few elliptic), 1.1–6 by 0.5–2.9 cm, length/width ratio 1.3–2.8, coriaceous, base (emarginate to oblique to) rounded to cuneate, margin reflexed, apex rounded to acute, mucronulate, upper surface green, lower surface papillate, glaucous grey-greenish to pale light greenish, often reddish near the margin, only nerves distinct, especially below, 5–7 per side. *Inflorescences* axillary fascicles (or staminate flowers on up to

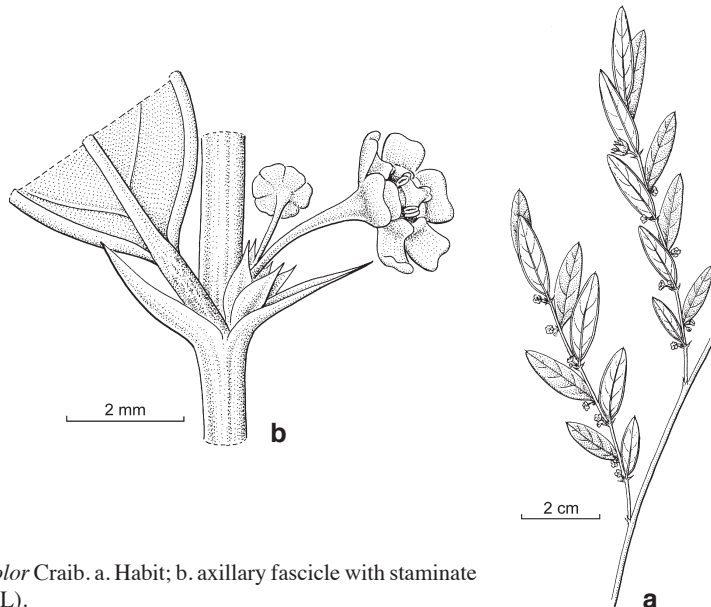
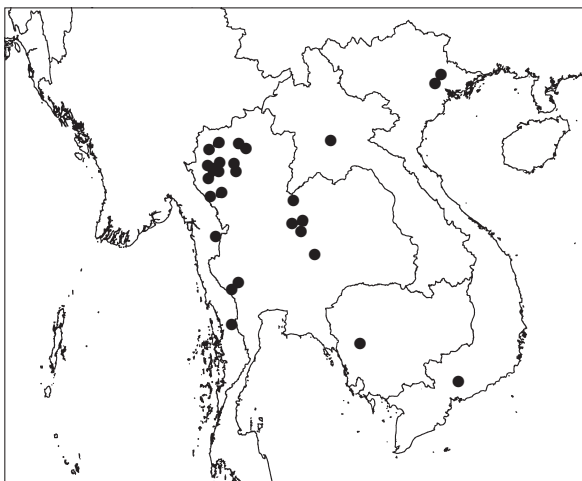


Fig. 5. *Sauropus bicolor* Craib. a. Habit; b. axillary fascicle with staminate flowers (*Kerr 6124*, L).





Map 6. Distribution of *Sauropus bicolor* Craib.

6 mm long racemes), flowers single (usually pistillate) or few together (usually staminate), usually all of the same sex. *Staminate flowers* 3–4.8 mm diam., light green; pedicel 2.8–5.5 mm long; calyx somewhat turbinate, up to 2 mm high, lobes shorter than cup, 0.6–1 by 1.3–2.2 mm, not to slightly apically split, apices usually rounded, scales large; stamens: androphore 0.7–1.1 mm long, anthers 0.3–0.8 by 0.3–0.6 mm, cream. *Pistillate flowers* 5.8–12(–14 in fruit) mm diam., light green to yellowish to partly tinged red; pedicel 1.2–2.1(–4.8 in fruit) mm long, light green; calyx lobes obovate, 1.8–3(–5) by 2–3(–5 in fruit) mm; ovary 1.2–1.7 by 2–2.2 mm; stigmas up to 1.2 mm long, horizontal, curled in more than a circle. *Fruits* ovoid, 7–7.5 by 5.5–6 mm, dry, not inflated, wider than high, white (to red); column c. 1.4 mm long, tapering towards apex. *Seeds* triangular in section, 3.9–4 by 2–3 by 2–2.3 mm.

**Distribution** — Myanmar, Thailand (Northern, North-eastern, Eastern, South-western floristic districts), Laos, Cambodia, Vietnam.

**Habitat & Ecology** — Open places in (degraded) deciduous (dipterocarp–oak) forest, dry dipterocarp forest or open pine forest; very secondary areas like open grassy ground, savannah, fire damaged vegetation, along roads, edges of forest, in bogs; soil: poor sand, clay, sandstone, limestone, granite and shale bedrock. Altitude 350–2175 m. Flowering: May to March; fruiting: May to October.

**Vernacular names** — Thailand: Ma yom tia, phak wan daeng (official Thai name), phak wan pa, yom dong; si siat phae (Lao).

**Note** — The leaves of the *S. bicolor* specimens show a continuous range in sizes, therefore, the variety *microphyllus* cannot be maintained (already the type specimen of the typical variety is intermediary).

## 8. *Sauropus brevipes* Müll.Arg. — Map 7

*Sauropus brevipes* Müll.Arg. (1863) 73; (1866) 242; Hook.f. (1887) 335; Pax & K. Hoffm. (1922) 222; Beille (1927) 653; Airy Shaw (1969) 44; (1972) 334; Whitmore (1973) 130; Chakrab. & M.G. Gangop. (1996) 524, f. 3; Smitinand (2001) 467. — *Aalius brevipes* (Müll.Arg.) Kuntze (1891) 591. — Type: *Wallich* 23? (holo G-DC n.v., 2 sheets, IDC microfiche DC herbarium 2461/12, 13), India, Prome.

*Sauropus parvifolius* Ridl. (1911) 175; (1924) 221; M.R. Hend. (1939) 72. — Type: *Ridley 15187* (holo K; iso BM), Malaysia, Kedah, Alor Sta.

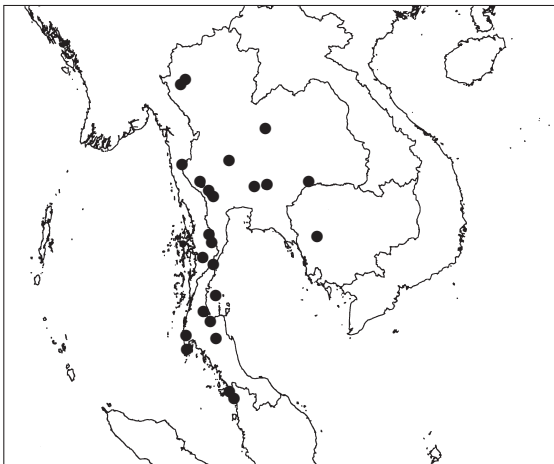
Woody herbs to shrubs, up to 1.5 m tall, often smelling of fenugreek when dry; branches with 2 relatively broad ribs, often with asperities between the ribs, glabrescent; flowering branches c. 0.5 mm thick. *Indumentum* absent. *Stipules* triangular to basally eared and falcate, 0.5–3.1 by 0.4–1.5 mm, membranous, persistent. *Leaves*: petiole 1.3–2.5 mm long, flattened above to squarish in transverse section; blade (ovate to elliptic to) obovate, 0.9–3.3 by 0.6–2.3 cm, length/width ratio 1.1–2.9, papery to chartaceous, base (emarginate to truncate to) cuneate, margin flat (to revolute), apex rounded to acuminate, mucronulate, upper surface dark green, lower surface light dull green, papillate; venation usually well visible beneath, nerves 6–8 per side, not raised, veins and veinlets reticulate. *Inflorescences* axillary fascicles, usually single or few staminate ones together, pale green to bright red. *Staminate flowers* 2–5 mm diam.; pedicel 2.5–6.2 mm long; calyx 1–2.7 mm deep, lobes 0.5–1.2 by 0.7–2.5 mm, apex slightly emarginate to rounded; stamens: androphore 0.2–0.3 mm long, anthers 0.2–0.3 by 0.2–0.3 mm. *Pistillate flowers* 5–7(–9 in fruit) mm diam.; pedicel 1.8–2.7 mm long; calyx lobes obovate, round to spade-like, 2.2–3.2 by 1.3–2.5 mm, 3 slightly smaller; ovary 0.6–1 by 1.5–1.8 mm; stigmas horizontal, up to 1.3 mm long, split for 0.6 mm, usually curled for less than a full circle. *Fruits* ovoid, c. 5 by 4 mm; column c. 4 mm long, tapering towards apex. *Seeds* triangular in transverse section, c. 3.7 by 2.3 by 2.3 mm.

Distribution — Myanmar, Thailand, Cambodia, N Peninsular Malaysia (Perlis, Kedah, Penang).

Habitat & Ecology — Mixed dry dipterocarp forest, deciduous forest, bamboo-evergreen forest, evergreen thickets, by streams, forest edges, sandy shores; soil: limestone, sand, red clay, granite. Altitude 0–700 m. Flowering: February, May to September, November; fruiting: February, May.

Vernacular name — Thailand: Kraduk kai dam (official Thai name); kham kao.

Note — Extremely similar to *S. quadrangularis*, but differing in smell of fenugreek (though this smell disappears with age of the specimen), the apically hardly to non-lobed



Map 7. Distribution of *Sauropus brevipes* Müll.Arg.

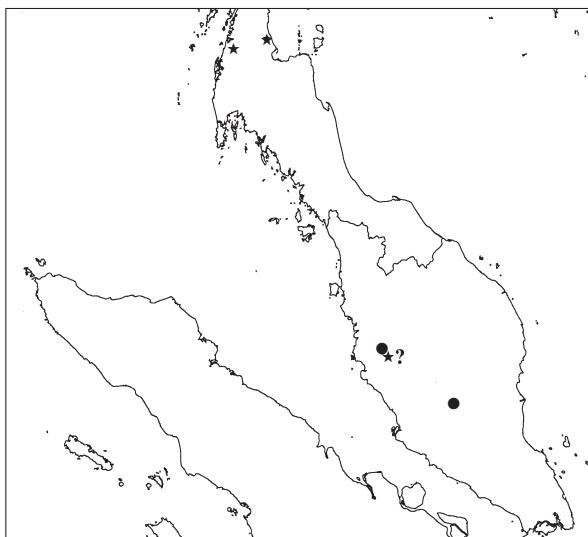
staminate sepals, and the horizontal stigmas. The latter is the most typical difference, especially in the north of Thailand. Also, *S. brevipes* often has asperities along the stem between the ribs, these are absent in the glabrous specimens of *S. quadrangularis* (check youngest branchlets).

### 9. *Sauropus calcareus* M.R. Hend. — Map 8

*Sauropus calcareus* M.R. Hend. (1933) 121; (1939) 72; Whitmore (1973) 130. — Type: *SF* (Henderson) 22316 (holo SING; iso K (4 sheets), KEP, NY), Malaysia, Pahang, Gunung Senyum limestone hill.

Shrublets, less than 50 cm tall; branches not ribbed, blackish, glabrous or hirsute, flowering branches 0.7–0.9 mm thick. *Indumentum* absent or of simple hairs. *Stipules* triangular, 1.5–2.3 by 0.8–1.2 mm, stiff, rather persistent. *Leaves*: petiole c. 1.5 mm long, roundish in transverse section, glabrous or hirsute; blade round to ovate, 1.4–2.8 by 1–2.3 cm, length/width ratio 1.2–1.4, very thin, almost translucent, base emarginate to truncate, very slightly peltate, margin flat, glabrous or especially basally hairy, apex emarginate to subacute, not mucronulate?, upper surface drying greyish green, lower surface drying more olive green, not papillate; venation raised on both sides and very distinct, nerves 6–8 per side, veins and veinlets reticulate, especially distinct near margin. *Inflorescences* axillary fascicles to very short racemes (up to 5 mm long); flowers single or few together, red. After Henderson (1933): *Staminate flowers* 1.6–2 mm diam.; pedicel up to 8 mm long, apex thickened; calyx 6-lobed, either lobes almost completely united, c. 0.5 by 1 mm, broad, apex rounded (glabrous specimen), or lobes almost free, very narrow, scale broader than lobes (hairy specimen); staminal column very short and broad. *Pistillate flowers* c. 3.5 mm diam.; pedicel 2–3 mm long; calyx lobes c. 1.9 by 1.5 mm; ovary c. 1 mm long; stigmas flat, bifid tips free, recurved. *Fruits* depressed globose, c. 4.5 mm diam.; black when dry. *Seeds* straw-coloured.

Distribution — Malaysia (Pahang, Perak).



Map 8. Distribution of *Sauropus calcareus* M.R. Hend. (●) and *S. discocalyx* Welzen (★).

Habitat & Ecology — On limestone. Flowering and fruiting: July.

Note — The species is known only from the glabrous (and rather poor) type, of which the isotypes in Kew still possess some staminate flowers. A second, unfortunately also scrappy specimen from Malaysia, Perak, *B. Molesworth-Allen s.n.* (SING), is very hairy and comprises one young staminate flower. Only one other *Sauropus* species has hairy and glabrous specimens: *S. quadrangularis*; usually the species is hairy or glabrous only. There is a big difference in staminate flowers between the two specimens, the glabrous type has hardly lobed staminate flowers, like many *Sauropus* species. The hairy specimens has staminate flowers like in *S. assimilis* Thwaites, *S. trinervius* Müll. Arg., and *S. micrasterias*: almost free calyx lobes which are very narrow with a scale broader than the free lobal part. The same has been found for *S. androgynus* and *S. rhamnoides* in the Philippines. It may also be that these two specimens belong to separate species and that the limestone habitat caused the resemblance in the very typical leaves.

#### 10. *Sauropus discocalyx* Welzen — Fig. 6; Map 8

*Sauropus discocalyx* Welzen (2001) 501, f. 1. — Type: Van Beusekom & Phengkhilai 566 (holo L; iso AAU, BKF, C, E, K, P), Thailand (Peninsular), Khao Saideng, near Ranong.  
*Sauropus bonii* auct. non Beille: Smitinand (2001) 467.

Shrublet with ascending habit, up to 0.5 m high; young branches with 4 distinct ribs. *Indumentum* absent. *Stipules* triangular, basally eared, 2.5–3 by 2–2.5 mm, stiff, rather persistent. *Leaves*: petiole 2.5–4 mm long, flattened above with 3 longitudinal (indistinct) ridges; blade (ovate to) elliptic, 11.5–17.5 by 5.8–7.2 cm, length/width ratio 2–2.3, papery, base attenuate, descending into petiole, margin flat, apex cuspidate, usually mucronulate, lower surface not papillate; venation flat to somewhat sunken above, distinct beneath, nerves 12–15 per side, veins and veinlets reticulate. *Inflorescences* cauliflorous at ground level to axillary, racemes (to panicles), up to 7.5 cm long, with per node groups of staminate flowers and a single pistillate flower; flowers sometimes on short, up to 2 mm long, branches with (sub)apically the pistillate flower. *Flowers* reddish green. *Staminate flowers* 12–13 mm diam.; pedicel 13.5–15 mm long; calyx hardly lobed, disc-like, translucent when mature; lobes very broadly triangular, 1–1.5 by c. 4.5 mm, patent, apex rounded, scales small; stamens: androphore c. 0.3 mm high, anthers c. 0.3 by 0.7 mm. *Pistillate flowers* c. 11 mm diam.; pedicel c. 13 mm long; calyx almost completely split, lobes only basally attached, obovate, c. 5 by 3 mm, more or less with claw, apex rounded; ovary obtriangular, c. 2 by 2 mm, basally very narrow, green; stigmas horizontal, c. 2 mm long, split till halfway, forming more than a circle, green. *Fruits* red, not seen. *Seeds* unknown.

Distribution — Thailand (northern part Peninsular floristic district: Chumphon, Ranong Province). Perhaps also in Malaysia (Perak).

Habitat & Ecology — Wet evergreen forest. Altitude 400–1500 m. Flowering: February, May.

Vernacular name — Thailand: Mayom bon.

Notes — 1. The two known specimens resemble *S. racemosus* Beille. The type of that species (*Balansa* 3202, P) is quite unlike *S. discocalyx* in the leaves (smaller and narrower: up to 10.5 by 3.5 cm, length/width ratio c. 3) and the staminate flowers (also broad, c. 15 mm diam., but very distinctly lobed, with lobes free till about halfway the

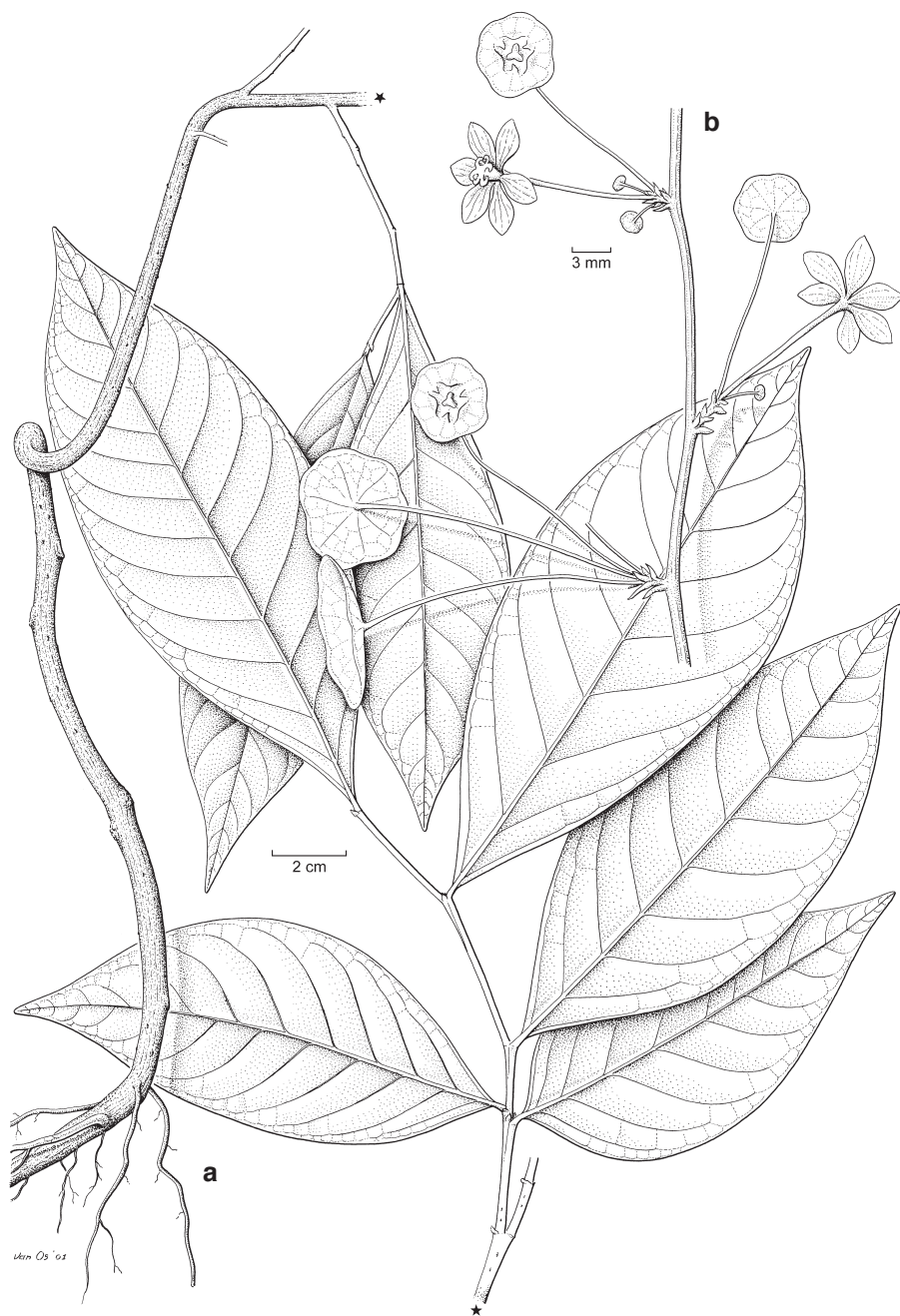


Fig. 6. *Sauropus discocalyx* Welzen. a. Habit; b. inflorescence with disc-like staminate flowers and normal pistillate flowers (Van Beusekom & Phengklai 566, L.).

calyx). A second specimen from Paris, doubtfully identified as *S. racemosus* (leaves basally rounded instead of narrowly cuneate), has pistillate flowers with short, up to 2.2 mm long, pedicels and an ovary which is basally rounded and not narrow, also the diameter of the flower is much smaller, c. 7 mm diam. and the calyx lobes are c. 3.5 by 2 mm.

2. A third specimen from Malaysia (Goping/Gopeng in Perak, *King's collector 477*) bears a strong resemblance to the Thai specimens in the leaves. The staminate flowers are still too young. The pistillate flowers are also somewhat younger.

### 11. *Sauropus garrettii* Craib — Map 9

*Sauropus garrettii* Craib (1914b) 284; Pax & K. Hoffm. (1922) 218, '*garrettii*'; Beille (1927) 646, '*garrettii*'; Airy Shaw (1972) 334; Chakrab. & M.G. Gangop. (1996) 528; Smitinand (2001) 467.

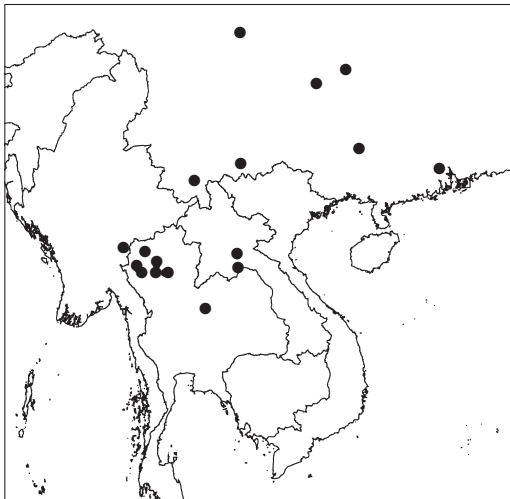
— Type: *Garrett 37* (holo K; iso L), Thailand, Doi Inthanon, N by E of the Pah Ngeam.

*Sauropus yunnanensis* Pax & K. Hoffm. (1922) 220. — Syntypes: *Henry 9359B* (K, 2 sheets), China, Mengtze; *Henry 13144* (K), China, Yunnan, Szemao.

*Sauropus chorisepalus* Merr. & Chun (1934) 10, pl. 5. — Type: *S.P. Ko 51462* (n.v.), China, Kwangtung Prov., Sunyi, Funshui Au (other referred specimens seen).

*Sauropus* spec., ? aff. *S. stipitato* Hook.f.: Airy Shaw (1972) 339, p.p. [pro *Garrett 864* (BK, K, L), Thailand, Chiang Mai, Doi Angka; *Kerr 6287* (BK, K, L), Thailand, Chiang Mai, Me Chem].

Shrubs to small trees, up to 3 m high; young branches 1.5–2 mm thick, with 2 ridges, in between ridges often (faint) asperities. *Indumentum* absent. *Bark* thin, smooth to finely pustular-lenticellate, grey. *Stipules* triangular, 2.5–4.2 by 0.3–1.2 mm. *Leaves*: petiole 2–3 mm long, flattened and ridged along margins and middle above, with very small asperities above; blade ovate (to elliptic), 1.7–12.8 by 1.1–4.2 cm, length/width ratio 1.5–3.2, papery, base cuneately to attenuately rounded, margin flat, apex acuminate, usually mucronulate, upper surface dull dark green, lower surface light greenish, usually papillate when leaves older; venation mainly flat and indistinct to distinct, usually somewhat raised beneath, midrib basally with minute asperities above, nerves 8–12 per side, veins and veinlets reticulate. *Inflorescences* axillary fascicles, flowers



Map 9. Distribution of *Sauropus garrettii* Craib.

single or in small groups of same or mixed sexes, seldom on short, up to 5 mm long racemes, greenish to pale yellow-green. *Staminate flowers* 4–6.5 mm diam.; pedicel 5–15 mm long; calyx up to 3.2 mm deep, fleshy, not lobed and circular to slightly 6-lobed, lobes at most 0.5–0.8 by 1.2–2.5 mm; stamens: androphore 0.1–0.4 mm long, anthers 0.4–0.7 by c. 0.4 mm, dull light orangish. *Pistillate flowers* 4–9.5 mm diam.; pedicel 3.8–13 mm long; calyx lobes almost free, ovate to obovate, often thick, apex rounded to bluntly acute, smaller ones 2–3.5 by 1–3.1 mm, larger ones 2.5–5 by 1.3–2.7 mm; ovary bell-shaped, 1–1.5 by 1–1.9 mm; stigmas 1–2 mm long, horizontal, split for 3/4th, slender, coiling in more than full circle, tan. *Fruits* ovoid to globose, 7–8 by 9–11 mm, broader than high, white, thin-walled, wall parts remaining stuck to base after dehiscence, spreading star-like, epicarp dehiscing from inner layers; column c. 6 mm long, tapering towards apex. *Seeds* triangular in section, 5.8–7 by 3.8–4 by 3.5–3.8 mm, black, with cavity subapically on adaxial axis.

Distribution — Myanmar, S China, Laos, N Thailand.

Habitat & Ecology — Mainly in shade in (margins of or disturbed places in) ever-green forest or deciduous forest with bamboo, in thickets, along stream banks, in cut-over forest; soil: limestone to granite bedrock. Altitude 550–1900 m. Flowering: June to September; fruiting: September, October.

Vernacular name — Thailand: Mayom ang ka.

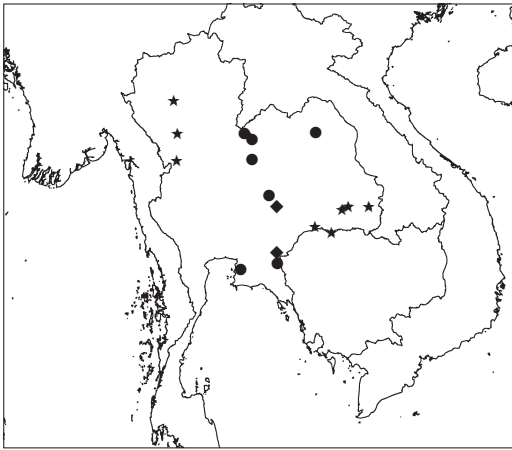
Note — Very similar to *S. androgynus* and *S. rhamnoides* (e.g. material from south-eastern Thailand was usually referred to *S. garrettii*). *Sauropus garrettii* has minute asperities on the branches, upper part of petiole and midrib.

## 12. *Sauropus granulosus* Airy Shaw — Fig. 3c; Map 10

*Sauropus granulosus* Airy Shaw (1969) 53; (1972) 335; Smitinand (2001) 467. — Type: *Kerr 8500* (holo K; iso BM), Thailand (Siam), North-eastern (Udawn Circle), Sakon Nakhon Prov., Wa Nawn.

Low shrubs, up to 1 m high; only very young branches with slight trace of ribs; flowering branches 0.5–1 mm thick. *Indumentum* absent. *Stipules* triangular to falcate, c. 1.2 by 0.5–0.6 mm, papery, rather persistent. *Leaves*: petiole 1.2–1.5 mm long, pulvinate, flattened; blade obovate, 0.8–2.7 by 0.5–1.5 cm, length/width ratio 1.6–1.8, pergamentaceous, base cuneate, margin flat to revolute, apex truncate to round, mucronulate, green above also when dry, chagrined, grey-green, papillate below; venation quite indistinct, nerves 5–7 per side, under sharp angle (less than 40°) with midrib, basal nerve reaching till about halfway blade, veins and veinlets indistinct, reticulate. *Inflorescences* axillary fascicles with flowers in small groups or single; flowers greenish white to yellowish to red. *Staminate flowers* 2–3.5 mm diam.; pedicel 1.8–3.7 mm long; calyx 0.5–2 mm high, inflexed lobes (those with emarginate apex) 0.6–1.3 by 0.6–1.2 mm, infolded apex grown with raised midrib, non-inflexed lobes (rounded apex) 0.7–1.2 by 0.6–1.2 mm; stamens: androphore c. 0.8 mm long, yellow, anthers 0.8–0.9 by 0.6–0.8 mm, orange-tan. *Pistillate flowers* 4.3(–7.7 in fruit) mm diam.; pedicel 1.8–2.8 mm; calyx lobes obovate, rounded, small ones 1.3–2.5 by 1.2–2.2 mm, larger ones 1.7–2.5 by 1.1–3 mm; ovary bell-shaped, apically flat, c. 1 by 1–1.2 mm, white; stigmas spreading to erect, c. 2 mm long, split in upper half, usually coiled for more than a circle, with basal to each stigma two fleshy, erect ovary lobes. *Fruits*





Map 10. Distribution of *Sauropus granulatus* Airy Shaw (●), *S. kerrii* Airy Shaw (★), and *S. pulchellus* Airy Shaw (◆).

ovoid, c. 5 by 7 mm, apically with rim formed by thickened apical ovary lobes; column c. 1 mm long, tapering towards apex. *Seeds* triangular in transverse section, 3.7–4 by 2–3 by 2.5–3 mm.

**Distribution** — Endemic in Thailand (North-eastern, Eastern and South-eastern floristic districts).

**Habitat & Ecology** — Usually in very open (disturbed) habitats like roadsides, dry thorny savannah, open deciduous forest with bamboo, locally common in open space; soil: rocky, sandstone. Altitude 200–600 m. Flowering: February to September; fruiting: March to August.

**Vernacular names** — Thailand: Mak khai lang (official Thai name); sano hin.

**Note** — This species strongly resembles *S. kerrii* (smaller leaves, more shiny), *S. pulchellus* (more distinct venation, basal nerve ending far below leaf middle), and *S. rostratus* (acute leaves, ribbed branches with asperities). See also the note under *S. pulchellus*.

### 13. *Sauropus heteroblastus* Airy Shaw — Map 11

*Sauropus heteroblastus* Airy Shaw (1969) 48; (1972) 335; (1974) t. 3708; Smitinand (2001) 467.

— Type: *Squires* 921 (holo K), S Vietnam, Dalat and vicinity.

*Sauropus compressus* auct. non Müll.Arg.: Beille (1927) 655.

Straggling, rheophytic shrub, up to 2 m high, stem red tinged, many short branches (less than 4 mm long) with (1 or) 2 (or 3) leaves and few flowers, stem with 2 raised lines; flowering branches 0.3–0.5 mm thick. *Indumentum* absent. *Stipules* triangular, 0.7–1.2 by 0.6–1.1 mm, chartaceous with membranous margins, rather persistent, those to the side branches larger, basally eared and with asperities along the lower margin. *Leaves*: petiole c. 1 mm long, flattened above, few asperities above; blades obovate, 4.5–32 by 4–20 mm, length/width ratio 1.1–1.6, somewhat coriaceous, base cuneate, margin flat, apex round to emarginate, mucronulate, surfaces green, with maroonish margins, lower surface slightly papillate; venation only nerves distinct below, nerves 5 or 6 per side, veins and veinlets indistinct, reticulate. *Inflorescences* axillary fascicles on side

branches; flowers in small groups or single, green to usually tinged red to maroonish. *Staminate flowers* 2.5–3 mm diam.; pedicel 5–5.5 mm long; calyx lobes ovate, 0.7–0.8 by 0.8–1 mm, apically slightly, shallowly lobed, lobes rounded; stamens: androphore 0.2–0.3 mm high, anthers 0.2–0.3 by 0.2–0.3 mm. *Pistillate flowers* 3–5.5 mm diam.; pedicel c. 1.5 mm long; calyx lobes obovate, almost free, 1.5–2.3 by 1.5–2.5 mm, apex spade-like; ovary 0.8–1 by c. 1.5 mm; stigmas horizontal, pig-tail-like wound, 0.5–1 mm long. *Fruits* not seen, depressed globose, c. 9 by 4–5 mm (Beille, 1927). *Seeds* not seen.

**Distribution** — Thailand (North-eastern and Eastern floristic districts), Cambodia, Vietnam.

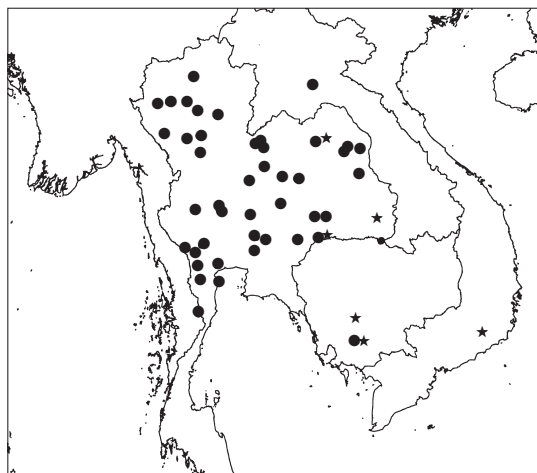
**Habitat & Ecology** — In small clumps on riverbanks, part of year dry; soil: sandstone. Altitude 100–200 m. Flowering: February, April.

**Vernacular names** — Thailand: Khrai hang nak. Cambodia: Prapep pii. Vietnam: Ka cha lei (Moi).

#### 14. *Sauropus hirsutus* Beille — Map 11

*Sauropus hirsutus* Beille (1927) 657; Airy Shaw (1972) 235; Smitinand (2001) 467. — Lectotype (selected here): *Pierre 564* (holo P), Cambodia, Samrong-tong.

Prostrate woody herbs to small shrubs, up to 40 cm (–2 m) high; roots thick; branches (sub)hirsute, green to red-brownish, round; flowering branches 1.5–2 mm thick. *Indumentum* of simple hairs, hirsute, sparse to dense on most parts. *Stipules* triangular to ovate, 1.8–4 by 0.7–2 mm, slightly hairy outside, glabrous inside, margins hirsute. *Leaves*: petiole 1.7–2.8 mm long, flat above, hairy; blade (ovate to) elliptic (to ob-ovate), 1.4–7.7 by 1–3.8 cm, length/width ratio 1.4–2.2, papery to pergamentaceous, base rounded to cuneate, margin sometimes revolute, apex (rounded to bluntly) acute, usually mucronulate, upper surface glabrous except for margin, basal part of midrib usually hairy, dark green, lower surface slightly to densely hairy, mainly on venation, light green; venation flat above, slightly raised below, nerves 5–9 per side, often distinct, veins and veinlets reticulate. *Inflorescences* axillary fascicles, flowers usually few



Map 11. Distribution of *Sauropus heteroblastus* Airy Shaw (★) and *S. hirsutus* Beille (●).

(to many) together of same or mixed sexes. *Staminate flowers* 1.5–4 mm diam., dark red; pedicel 1.4–4.3 mm long, (sub)glabrous, light greenish to reddish in upper part; calyx 6-lobed, lobes 0.4–1.8 by 0.6–1.3 mm, slightly hairy outside and along margin, glabrous inside; stamens glabrous: androphore 0.2–0.3 mm high; anthers 0.2–0.3 by 0.2–0.4 mm. *Pistillate flowers* 5–15 mm diam., usually greenish; pedicel 2.4–4(–7 in fruit) mm long, hirsute; calyx lobes 6, only at very base attached, hairy outside, glabrous inside, 3 smaller, elliptic to obovate, 2.2–5.5 by 1.4–3 (to 5.8 by 3.8 in fruit) mm, apex rounded to acute, 3 larger ones elliptic, 3.2–13 by 2.2–4.5 mm, apex acute; ovary 1–1.8 by 1.3–2.7 mm, glabrous; stigmas 1.2–1.4 mm long, horizontal, free part 0.6–0.8 mm long, forming a half to complete circle, green to dark red. *Fruits* ovoid, 5–8 by 5–8 mm, usually broader than high, apically with corona; column c. 2.5 mm long, tapering towards apex. *Seeds* triangular in section, c. 5 by 2.7 by 2.7 mm.

Distribution — Laos, Thailand (except Peninsular District), Cambodia.

Habitat & Ecology — Mainly in the understorey in secondary areas of (open) deciduous forest, dry dipterocarp forest, bamboo forest, teak forest, secondary growths, open thickets, grassy (buffalo grazing) ground, waste land; along railways and roads, locally common; soil: sand, clayey soil with as bedrock limestone, shale, or granite, once recorded from silty soil. Altitude 50–930 m. Flowering: April to October; fruiting: August, September.

Vernacular names — Thailand: Kom koi, phak wan nok (official Thai name), tai bai (South-western District); kongkoi lot khon (Central District); ra ngap manut (Peninsular District). NB. no specimens from the Peninsula were seen, but as the species is present in the province Prachuap Khiri Khan it may easily extend to Chumphon, for which the Peninsular name was noted.

Note — *Put 1829* (Kanchanaburi, Sai Yok) is (sub)glabrous; this is the only exceptional form found.

## 15. *Sauropus kerrii* Airy Shaw — Map 10

*Sauropus kerrii* Airy Shaw (1969) 52; (1972) 336; Smitinand (2001) 467. — Type: *Kerr 21541* (holo K; iso BM, L), Thailand (Siam), Eastern (Ubon Circle), Ubon Ratchathani Prov., Chiet.

Minute shrublets, up to 35 cm high, deciduous?, branches with 2 or 4 indistinct ribs, reddish, flowering branches c. 0.4 mm wide. *Indumentum* absent. *Stipules* triangular, 0.7–2.5 by 0.3–0.8 mm. *Leaves*: petiole c. 1 mm long, flat above; blade obovate, 5.2–12 by 3–7 mm, length/width ratio 1.3–1.7, pergamentaceous, base rounded to cuneate, margin flat to revolute, apex truncate to round, mucronulate, green above, somewhat shiny, whitish green underneath, brown when dry; venation indistinct, nerves 4–6 per side, veins and veinlets reticulate. *Inflorescences* axillary fascicles, with staminate flowers single or in small groups, or single pistillate ones; flowers white. *Staminate flowers* 2.6–3.2 mm diam.; pedicel 2–4.2 mm; calyx 1 mm high, lobes either folded inside and grown together with raised midrib, emarginate, 0.6–0.8 by 1–1.3 mm, or somewhat involute, obovate, 0.6–1.2 by 1–1.2 mm, all without scales; stamens: androphore 0.5–1 mm long, anthers erect, 0.7–1.1 by 0.6–0.7 mm. *Pistillate flowers* 5–6.8(–12.5 in fruit) mm diam.; pedicel 1–1.5 mm long; sepals obovate, 1.3–2.2 by 1.8–3 mm; ovary spindle-shaped, c. 1 by 2 mm; stigmas erect, 1.8–2.1 mm long, split halfway, only upper part of split inrolled and papillate above, basal to each stigma two

fleshy, erect ovary lobes. *Fruits* flattened, circular, c. 7 by 3.5 mm, apically without or with rim around persistent stigmas formed by thickened apical ovary lobes; column not seen, probably breaking off completely. *Seeds* triangular in transverse section, c. 3.2 by 3 by 2.5 mm.

Distribution — Endemic to Thailand (disjunct in Northern and Eastern floristic districts).

Habitat & Ecology — Deciduous forest, dry dipterocarp forest, open savannah, on poor gravely or sandy soil. Altitude 100–600 m. Flowering: April to August; fruiting: May, June.

Vernacular name — Thailand: Ya hun hai.

Notes — 1. The specimen from Tak (Northern) had a rim on the fruit, while this was absent in a specimen from the Eastern part of Thailand.

2. See also note under *S. granulatus*.

### 16. *Sauropus macranthus* Hassk. — Fig. 3b; Map 12

*Sauropus macranthus* Hassk. (1855) 166; (1858) 52; Müll.Arg. (1866) 240; Backer & Bakh.f. (1964) 471; Airy Shaw & Radcl.-Sm. (1967) 34, f. 13; Airy Shaw (1972) 336; Whitmore (1973) 131; Airy Shaw (1975) 193; (1980a) 200; (1980b) 681; (1981) 343; (1983) 44; Chakrab. & M.G. Gangop. (1996) 529, f. 6; Smitinand (2001) 467. — *Aalius macranthus* (Hassk.) Kuntze (1891) 591, '*macrantha*'. — Type: *Teijsmann s.n.* (L, barcode L0138428), Indonesia, Hortus Bogoriensis.

*Sauropus spectabilis* Miq. (1860) 446; Müll.Arg. (1866) 240; Pax & K. Hoffm. (1922) 219; Ridl. (1924) 220; Beille (1927) 647; M.R. Hend. (1939) 30, 72. — *Aalius spectabilis* (Miq.) Kuntze (1891) 591. — Type: *Teijsmann HB 4481* (holo U), Indonesia, Sumatra, Lampung Prov. (Lampung), Radja-bassa.

*Sauropus macrophyllus* Hook.f. (1887) 333, p.p.; Pax & K. Hoffm. (1922) 226. — *Aalius macrophyllus* (Hook.f.) Kuntze (1891) 591, '*macrophylla*'. — Lectotype (selected here): *Griffith KD 4834* (K), India, Upper Assam, Mishmi Hills at Laee Pane and Yen. (Other, former syntype, *Griffith KD 4828* = *S. rhamnoides*.)

*Sauropus forcipatus* Hook.f. (1887) 334; Pax & K. Hoffm. (1922) 218; Ridl. (1924) 220. — *Aalius forcipatus* (Hook.f.) Kuntze (1891) 591, '*forcipata*'. — Type: *Scortechini 1254* (holo K), Malaysia, Perak.

*Glochidion umbratile* Maiden & Betche (1905) 370. — Type: *E. Betche s.n.* (holo NSW, barcode NSW247350), Australia, North Queensland, Atherton, Aug. 1901.

*Sauropus robinsonii* Merr. (1912) 407; Pax & K. Hoffm. (1922) 220; Merr. (1923) 405. — Type: *Elmer 6441* (holo PNH<sup>+</sup>; iso BM, K (2 sheets), L, P), Philippines, Luzon, Benguet Subprov., Kias.

*Sauropus wichurae* Müll.Arg. ex Pax & K. Hoffm. (1922) 220. — Lectotype (proposed here): *Wichura 2104* (holo G), Indonesia, Java, Tjisurupan.

*Sauropus grandifolius* Pax & K. Hoffm. (1922) 222; Beille (1927) 648. — *Henry 11765A* (holo K; iso K, 2 sheets), China, Yunnan, Szemao.

*Sauropus grandifolius* Pax & K. Hoffm. var. *tonkinensis* Beille (1927) 648. — Type: *Balansa 3842* (holo P; iso K), Vietnam, Tonkin, vallée de Lankok, mont Bavi.

*Sauropus longipedicellatus* Merr. & Chun (1934) 34. — *H.Y. Liang 61709* (holo NY; iso A), China, Hainan, Seven Finger Mountain.

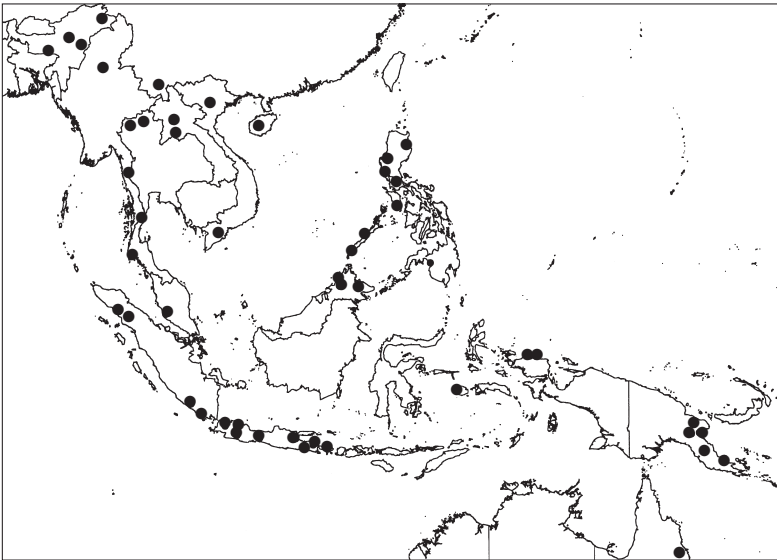
Shrubs to treelets, up to 5 m high, up to 22 mm dbh; branches spreading horizontally, with 2, often indistinct ribs, flowering branches 2–4 mm thick. *Indumentum* absent. *Bark* thin, smooth, tan to greyish brown. *Stipules* triangular, 2.3–8.5 by 1.3–2.8 mm, basally eared, dark brown when dry with yellowish margin, stiff, breaking off easily, not caducous. *Leaves*: petiole 3–5 mm long, cracked when dry, flattened above but with marginal and midrib ridges; blade ovate (to elliptic), 3.8–20 by 1.9–8.2 cm,

length/width ratio 1.6–3.5, papery, base broadly cuneate, margin flat, apex (gradually) cuspidate, usually mucronulate, upper surface glossy dark green above, lower surface lighter bright green, never papillate; venation distinct on both sides but hardly raised, nerves 10–17 per side, veins more or less scalariform, veinlets reticulate. *Inflorescences* axillary fascicles, flowers pendent, usually single or few together of same or mixed sexes. *Staminate flowers* 2.5–4.5 mm diam., red; pedicel 7.5–15 mm long; calyx 1.5–2.8 mm deep, 6-lobed, lobes triangular, 0.5–1.2 by 1–2 mm, leathery, apex rounded to emarginate, scales low; stamens: androphore c. 0.2 mm high, anthers c. 0.3 by 0.3–0.6 mm. *Pistillate flowers* 3.5–12 mm diam., greenish red to red to purplish; pedicel up to 7.5 cm long in fruit, apically more than 1 mm thick; calyx lobes 6, only at very base attached, thick, 3 smaller, c. square to ovate, 2.2–3 by 2.3–3 mm; larger ones elliptic, 3–5.3 by 2.2–3.1 mm; ovary bell-shaped to ellipsoid, 2–2.5 by 2.2–3 mm, stigmas horizontal, c. 2 mm long, upper 2/3rd split, thick, curled in more than a complete circle, free from ovary. *Fruits* flattened globose to somewhat lobed, 17–22 by 10–13 mm, broader than high, (pink to) red to purplish, wall thin, mericarp white and edible; column c. 9 mm long, tapering towards the apex. *Seeds* triangular in transverse section, hollow adaxially, 10–10.5 by 6.5–8 by 5–6 mm, black or brown.

Distribution — NE India to S China, SE Asia, throughout Malesia to N Australia (Queensland).

Habitat & Ecology — (Dry) evergreen forest, primary forest, secondary forest (with much bamboo), scrub; very dry to swampy, along rivers, ridges, on steep slopes; soil: deep fertile soil, humus rich to swampy boulder strewn soil; limestone bedrock. Altitude 200–2000 m. Flowering and fruiting throughout the year, though somewhat less from December to February.

Uses — On Java planted as ornamental. Mericarp edible. Leaves sometimes used as vegetable, but less popular than *S. androgynus*.



Map 12. Distribution of *Sauropus macranthus* Hassk.

Vernacular names — Thailand: Mayom khao. Sumatra: Gening-gening (Karo). Java: Manis manis. Irian Jaya: Nibasam (Andjai).

Note — This species has – within *Sauropus* – large leaves, but especially in Australia the leaves are usually much smaller (less than 10 cm). On Java the pistillate pedicels remain shorter than in the other areas, within the length range of *S. rhamnoides*. The latter species can relatively easily be distinguished from *S. macranthus*, even when in pistillate flower only, as it has caducous stipules and a very different kind of staminate flower (calyx enlarged, circular, hardly lobed).

### 17. *Sauropus micrasterias* Airy Shaw — Fig. 2b; Map 4

*Sauropus micrasterias* Airy Shaw (1960) 354; (1963) 344; (1975) 194. — Type: *Jacobs 5179* (holo K; iso L), Sarawak, 1st Division, rock formation (Bau series) W and E of passage of Sungei Serin (30 miles S of Kuching).

Shrub (with creeping habit), up to 1.5 m high, sprouting from long roots; young branches with 2 faint ribs, flowering branches at least 4 mm thick. *Indumentum* absent. *Stipules* triangular, basally eared, 2.5–3 by 1.1–1.3 mm, stiff, rather persistent. *Leaves*: petiole 3–4 mm long, flattened above; blade elliptic (to somewhat obovate), 14–20.5 by 6.3–8.5 cm, length/width ratio 2.2–2.4, papery, base cuneate, descending into petiole, margin flat, apex cuspidate, not mucronulate, lower surface not papillate; venation rather distinct on both sides, especially beneath, nerves 12–15 per side, veins more or less scalariform, veinlets reticulate. *Inflorescences* cauliflorous near ground to axillary, racemes (to panicles), up to 14 cm long, red, often with some asperities, with per node groups of staminate flowers and a single pistillate flower; staminate flowers sometimes on short, up to 5 mm long, branches. *Flowers* dull raspberry red to dark red. *Staminate flowers* 5.5–8 mm diam.; pedicel 5–6 mm long; calyx c. 4 mm deep; lobes narrowly triangular, c. 3 by 0.9–1 mm, erect, apex rounded, scales slightly broader than lobes; stamens: androphore c. 0.3 mm high, anthers c. 0.5 by 0.7 mm, cream. *Pistillate flowers* c. 4 mm diam.; pedicel c. 2.2 mm long; calyx almost completely split, lobes only basally attached, obovate, 3 smaller, c. 2 by 1.3 mm, 3 larger, c. 2.5 by 1.3 mm, apex rounded; ovary c. 1 by 1.3 mm, pinkish; stigmas horizontal, c. 1 mm long, split till halfway, forming less than a circle. *Fruits* and *seeds* unknown.

Distribution — Endemic in Sarawak, near Kuching.

Habitat & Ecology — Primary and secondary forest at foot of limestone hills, land wet (recorded once) with scattered limestone boulders; soil: yellow clay loam, limestone. Altitude 70–400 m. Flowering: March, August, October.

Note — See note under *S. thyrsiflorus*.

### 18. *Sauropus orbicularis* Craib — Map 13

*Sauropus orbicularis* Craib (1914b) 284; Pax & K. Hoffm. (1922) 223; Beille (1927) 655; Airy Shaw (1969) 45; (1972) 336; Smitinand (2001) 467. — Type: *Kerr 2635* (holo K; iso BM, CAL), Thailand, Chiang Mai Prov., Doi Sutep.

*Sauropus orbicularis* Craib var. *minor* Airy Shaw (1969) 45; (1972) 337. — Type: *Kerr 1339* (holo K), Thailand (Siam), Northern (Payap Circle), Chiang Mai Prov., Doi Sutep.

*Sauropus siamensis* Chakrab. & M.G. Gangop. (1995) 452, f. 2. — Type: *Kerr 2635* (holo CAL; iso BM, K), Thailand, Chiang Mai Prov., Doi Sutep. See note 2.

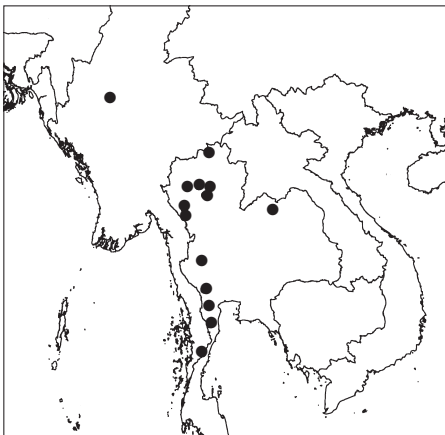
Woody herbs to small shrubs, up to 1 m high; woodstock perennial; branches with 4 ridges, flowering branches 0.4–1 mm thick. *Indumentum* absent. *Stipules* triangular to falcate, 0.7–1.2 by 0.5–0.8 mm, persistent. *Leaves*: petiole 1.4–1.5 mm long, flat above, often squarish in transverse section; blade (elliptic to) obovate to almost orbicular, 0.6–3 by 0.35–2.3 cm, length/width ratio 1.2–2, papery to pergamentaceous, base cuneate to attenuate, margin flat to somewhat revolute, apex rounded to acute, mucronulate, upper surface dark green, usually silica filled cells on top of venation well visible, lower surface light greenish greyish, papillate; venation very distinct on both sides, nerves 5 or 6 per side, veins and veinlets reticulate. *Inflorescences* axillary fascicles; flowers usually solitary to few together of both sexes, light yellow (to deep purple). *Staminate flowers* 1.8–2.3 mm diam.; pedicel 2.3–5.2 mm long; calyx c. 1.4 mm deep, lobes hardly distinguishable, 0.2–0.4 by 0.7–1 mm, slightly lobed with rounded apices; stamens: androphore c. 0.2 mm high, anthers c. 0.2 by 0.2 mm. *Pistillate flowers* 3–4.3(–7 in fruit) mm diam.; pedicel 1.3–2.2 mm long; calyx lobes spade-like, 1.2–1.4(–2 in fruit) by 1.2–1.7(–2.3 in fruit) mm; ovary obpyramidal, c. 0.7 by 1.4 mm; stigmas horizontal, up to 1 mm long, becoming erect in fruit, split in upper third, coiled for more than a full circle. *Fruits* ovoid, 6–6.5 by c. 5 mm, broader than high; column c. 2 mm long, tapering towards apex. *Seeds* triangular in section, c. 3.5 by 2.2 by 2.3 mm.

**Distribution** — Myanmar, Thailand (Northern and South-western floristic districts), Laos (Vientiane Province).

**Habitat & Ecology** — Mainly in secondary deciduous forest or dry dipterocarp forest, also in secondary scrub with much bamboo, on dikes along rice fields, or in grass in open forest, along forest margins and streamlets, areas often fire prone; granite or limestone bedrock. Altitude 50–730 m. Flowering: April to September (November); fruiting: May to September.

**Vernacular name** — Kwang-khao-yi, klam phi (official Thai name).

**Notes** — 1. Variety *minor* could not be maintained, because there is a gradual transition from large-leaved specimens in Chiang Mai (Northern) to small leaved specimens in Prachuap Khiri Khan (South-western); moreover, several specimens show larger and very small leaves on the same plant (e.g., *Maxwell* 85-820, L).



Map. 13. Distribution of *Sauropus orbicularis* Craib.



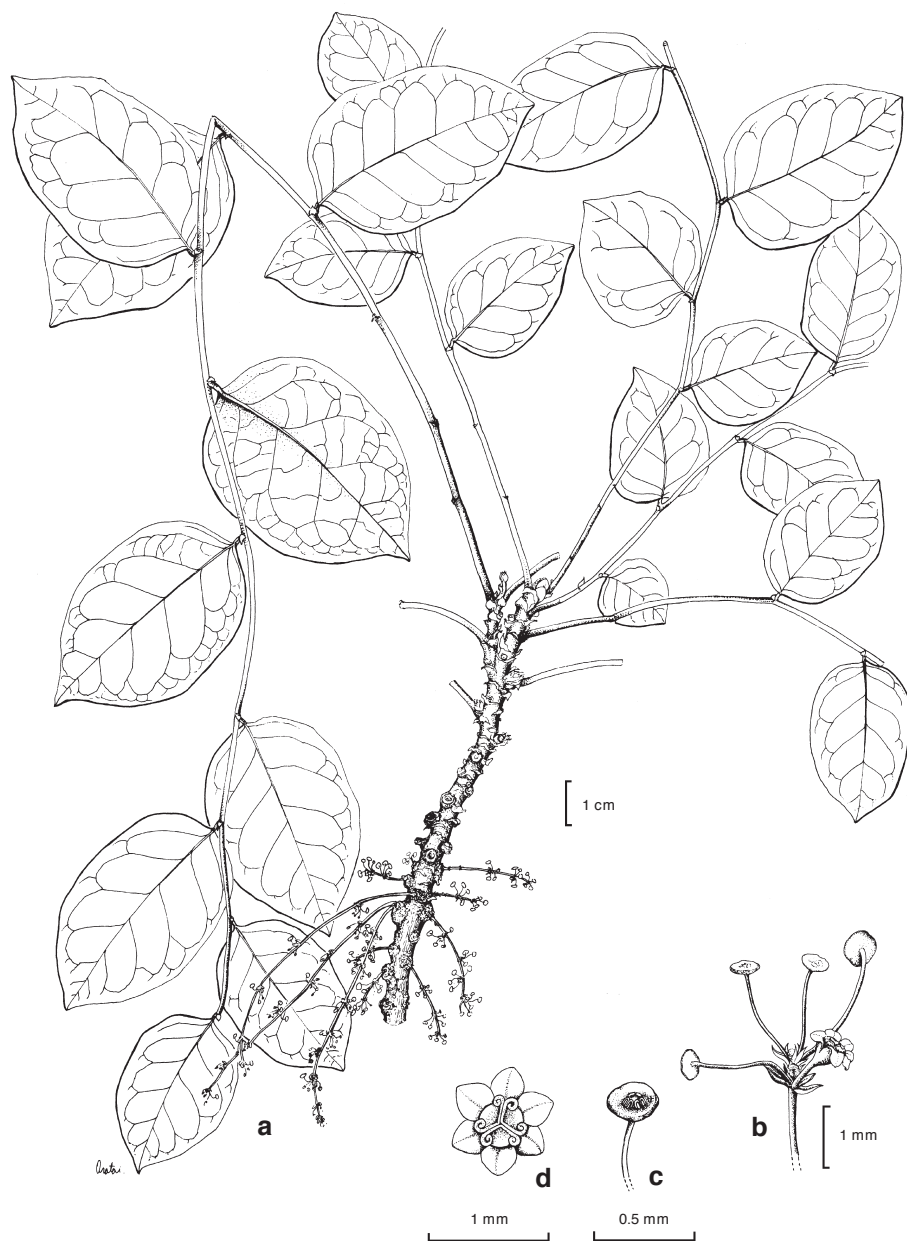


Fig. 7. *Sauropus poomae* Welzen & Chayamarit. a. Habit; b. node of inflorescence with a pistillate and several staminate flowers; c. staminate flower; d. pistillate flower (*Pooma, Mauric & Greijmans 1470*, BKF).

2. The type of *S. siamensis* is a duplicate of the type of *S. orbicularis*. The duplicate in Calcutta does not deviate from *S. orbicularis*, therefore the name *S. siamensis* is placed into the synonymy of *S. orbicularis*.

3. Very similar to *S. quadrangularis* but differing in the leaves which dry greenish instead of brownish, the silica holding cells around the veins which stick out after drying (veins flat in *S. quadrangularis*), the hardly lobed staminate calices and the flat stigmas in the pistillate flowers (more deeply lobed staminate calices and erect stigmas in *S. quadrangularis*).

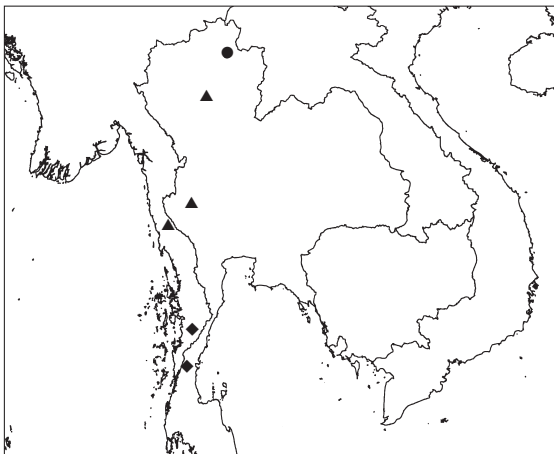
4. The Chinese *S. delaveyi* Croizat is quite similar to the small leaved forms of *S. orbicularis*, only the leaves of *S. delaveyi* miss the typical silica-filled cells on top of the veins.

### 19. *Sauropus poomae* Welzen & Chayamarit — Fig. 7; Map 14

*Sauropus poomae* Welzen & Chayamarit [ex Smitinand (2001) 467, nom. nud.] (2001) 652, f. 3. —

Type: *Pooma*, Mauric & Greijmans 1470 (holo BKF), Thailand, Chiang Rai Prov., Doi Tung.

Undershrubs, up to 50 cm high, creeping, stem apically with dense groups of stipules and scars of branches; branches terete, cauliflorous, stems c. 6 mm thick. *Indumentum* absent. *Stipules* triangular, 2.2–3.5 by 2–3.5 mm, basally eared, stiff, recurved, breaking off. *Leaves*: petiole 2–3 mm long, flattened above; blade ovate to triangular, 3.7–7.3 by 2.6–4.6 cm, length/width ratio 1.4–1.6, papery, base truncate, margin flat to recurved, apex acute, often mucronulate; venation especially visible above, nerves 9–11 per side, veins and veinlets laxly reticulate. *Inflorescences* single or groups of racemes, up to 11 cm long, with per node several staminate and one pistillate flower. *Flowers* reddish brown to dark purple. *Staminate flowers* 1.6–2.3 mm diam.; pedicel 5.5–6 mm long; calyx hardly lobed, 0.8–1 mm deep, lobes 0.2–0.4 by 0.5–1.5 mm, apex rounded; stamens: androphore c. 0.3 mm high, anthers 0.4–0.5 by c. 0.5 mm. *Pistillate flowers* 3–4 mm diam.; pedicel 0.8–1 mm long; calyx lobes ovate to round, 1.2–1.6 by 1–1.6 mm, thick, spreading, apex rounded; ovary widely bell-shaped, 0.8–1 by 1.1–1.7 mm; styles up to 1 mm long, horizontal, split till halfway, making less than half circle. *Fruits* unknown.



Map 14. Distribution of *Sauropus poomae* Welzen (●), *S. subterblancus* (C.E.C. Fisch.) Welzen (◆), and *S. thyrsiflorus* Welzen (▲).

Distribution — Endemic in Thailand (Northern floristic district: Chiang Rai Prov., Doi Tung).

Habitat & Ecology — In shade of montane forest, creeping over rugged limestone, common. Altitude 1250–1300 m. Flowering: March, October.

Vernacular name — Dok tai ton.

Note — Named after the main collector of both known specimens: Rachun Pooma (BKF herbarium).

## 20. *Sauropus pulchellus* Airy Shaw — Map 10

*Sauropus pulchellus* Airy Shaw (1969) 54; (1972) 337; Smitinand (2001) 467. — Type: *Kerr 20472* (holo K), Thailand (Siam), Eastern Region, Rachasima Circle, Nakhon Ratchasima Prov. (Korat), Ta Chang.

Small shrubs, up to 40 cm high; branches glabrous with 2 or 4 raised ribs, flowering branches 0.3–0.8 mm diam. *Indumentum* absent. *Stipules* triangular to falcate, 1–1.2 by 0.3–0.8 mm, basally often eared, papery, quite persistent. *Leaves*: petiole c. 1 mm long, pulvinate; blade obovate, 7–26 by 5–10.5 mm, length/width ratio 2–2.5, chartaceous, base rounded, margin flat, apex slightly emarginate to rounded, shortly mucronulate, greenish when dry, lower surface glaucous, papillate, venation strongly raised on both sides, tertiary venation partly visible, nerves 5–8 per side, basal nerve ending far below middle, under more than 40° with midrib. *Inflorescences* axillary fascicles consisting of 1 or more staminate flowers (these sometimes in up to 2 mm long racemes) or of single pistillate flowers. *Staminate flowers* 1.7–3 mm diam.; pedicel 1.5–2.3 mm long; calyx hardly lobed, lobes obovate, 3 with inflexed apex, grown with raised midrib, 0.3–0.5 by 0.7–1 mm, larger ones 0.7–1.2 by 0.9–1.1 mm, top rounded to emarginate, thick or hooded, no scales; stamens: androphore 0.6–1.2 mm long; stamens erect, free (but seemingly connate), 0.7–0.8 by 0.4 mm. *Pistillate flowers* 2.7–4 mm diam.; pedicel c. 1 mm long; calyx lobes obovate, 1.3–3 by 1–1.5 mm; ovary bell-shaped, 1.5–2 by 1.8–2.8 mm; stigmas erect, with basal to each stigma two fleshy erect ovary lobes. *Fruits* depressed globose, c. 5 by 5 mm, apically with raised rim around persistent stigmas formed by thickened apical ovary lobes. *Seeds* triangular in transverse section, 3–4 by 2–3 by 2–3 mm.

Distribution — Endemic to Thailand (Eastern and South-eastern floristic districts).

Habitat & Ecology — Open deciduous forest. Altitude 50–200 m. Flowering: May, October.

Vernacular name — Thailand: Sano hin.

Note — *Sauropus pulchellus* strongly resembles *S. granulosus*, but the veins are much more obvious than in the latter, raised on both sides, even the greater part of the tertiary venation is visible and the nerves have a far less sharp angle with the midrib, while the basal nerves end far below the middle of the leaf. Moreover, the calyx of the staminate flowers is hardly lobed.

## 21. *Sauropus quadrangularis* (Willd.) Müll.Arg. — Fig. 3c; Map 15

*Sauropus quadrangularis* (Willd.) Müll.Arg. (1863) 73; (1866) 242; Kurz (1877) 350; Hook.f. (1887) 335; Pax & K. Hoffm. (1922) 223; Gamble (1925) 1303; Beille (1927) 654; Airy Shaw (1972) 337; Chakrab. & M.G. Gangop. (1996) 534, f. 9a–d; Philcox (1999) 107. — *Phyllanthus quadr-*

- angularis* Willd. (1805) 585. — *Aalius quadrangularis* (Willd.) Kuntze (1891) 591. — *Sauropus quadrangularis* (Willd.) Müll.Arg. var. *quadrangularis* Smitinand (2001) 467 — Type: *Hb. Willdenow* 17985 (holo B-W n.v.; IDC microfiche 7440), India.
- Phyllanthus rhamnoides* auct. non Willd.: Roxb. (1832) 663 — *Ceratogynum rhamnoides* Roxb. ex Wight (1852) t. 1900. — *Sauropus ceratogynum* (Roxb. ex Wight) Baill. (1858) 635; Müll.Arg. (1866) 243. — *Aalius ceratogynus* (Roxb. ex Wight) Kuntze (1891) 591, '*ceratogynum*'. — Lectotype (proposed here): Roxburgh *Icones* pl. 267 (K).
- [*Phyllanthus tenellus* Wall. (1847) 7892A, nom. nud.; auct. non Roxb. [(1814) 69, nom. nud.] (1832) 668, non Benth. (1844) 165.] — *Phyllanthus leschenaultii* Müll.Arg. var. *tenellus* Wall. ex Müll.Arg. (1863) 38. — Type: Wallich 7892A (K-W), India. NB. Roxburgh *Icones* pl. 1913 with the name *P. tenellus* is a real *Phyllanthus*.
- [*Phyllanthus bacciformis* Ham. ex Wall. (1847) nr. 7909, nom. nud., pro *Hb. Hamilton in Wallich* 7909 (K-W), India, Morung.]
- Sauropus rigidus* Thwaites (1864) 284; Müll.Arg. (1863) 73; (1866) 243; Hook.f. (1887) 336; Trimen (1898) 17; Pax & K. Hoffm. (1922) 224; Chakrab. & M.G. Gangop. (1996) 539, f. 12. — Type: Thwaites *CP* 2135 (holo K; iso BM n.v., CAL (2 sheets) n.v., G (2 sheets), PDA n.v.), Sri Lanka.
- Sauropus compressus* Müll.Arg. (1866) 243; Kurz (1877) 350; Hook.f. (1887) 336; Pax & K. Hoffm. (1922) 224; Beille (1927) 655; Chakrab. & M.G. Gangop. (1996) 526. — *Aalius compressus* Kuntze (1891) 591, '*compressa*'. — *Sauropus quadrangularis* (Willd.) Müll.Arg. var. *compressus* (Müll.Arg.) Airy Shaw (1972) 337; Smitinand (2001) 467. — *Sauropus compressus* Müll.Arg. var. *compressus* Chakrab. & M.G. Gangop. (1996) 526, f. 4. — Syntypes: *J.D. Hooker s.n.* (G-DC n.v., IDC microfiche DC herbarium 2489/5; K (2 sheets)), Sikkim, Regio Trop.
- Sauropus quadrangularis* (Willd.) Müll.Arg. var. *puberulus* Kurz (1877) 350; Hook.f. (1887) 335 (note under *S. quadrangularis*); Airy Shaw (1972) 337; Smitinand (2001) 467. — *Sauropus compressus* Müll.Arg. var. *puberulus* (Kurz) Chakrab. & M.G. Gangop. (1996) 528. — Type: Kurz 1586 (CAL), Myanmar (Burma).
- Sauropus pubescens* Hook.f. (1887) 335; Ridl. (1911) 175; Pax & K. Hoffm. (1922) 225; Gamble (1925) 1303; Beille (1927) 656. — *Aalius pubescens* (Hook.f.) Kuntze (1891) 591. — Syntypes: Clarke 11650A & Clarke 11650B (K), India, Eastern Himalaya, Siligoree, at the foot of the Sikkim Hills. See note 2.
- Sauropus concinnus* Collett & Hemsl. (1891) 123, pl. 18; Pax & K. Hoffm. (1922) 224. — Type: Collett 818 (K n.v.), Myanmar, Shan hills.

Woody herbs to small shrubs, up to 2 m high; rootstock woody; branches with 2 or 4 raised ribs, most parts often tinged red, brown when older, flowering branches 0.3–0.5 mm thick. *Indumentum* absent or of simple hairs, hirsute, usually sparse on most parts. *Stipules* triangular to sometimes strongly falcate, 1–2.7 by 0.7–1.2 (–3.5 when falcate) mm, glabrous to subhirsute outside, glabrous inside. *Leaves*: petiole 1.2–1.3 mm long, round, glabrous to hirsute; blade (ovate to) elliptic to obovate, 0.6–4.1 by 0.5–1.8 cm, length/width ratio 1.4–2.3, papery to chartaceous, base often slightly oblique and asymmetric, truncate to cuneate, margin often revolute, sometimes with asperities (then plant pilose), often maroonish, apex slightly emarginate to rounded, often mucronulate, upper surface green to dark green, lower surface light to grey-green beneath, papillate, glabrous to densely hairy on both sides especially beneath; venation slightly raised above, raised beneath, nerves c. 6 per side, distinct, veins and veinlets reticulate. *Inflorescences* axillary fascicles, flowers usually few together of same or mixed sexes; flowers yellow to deep red. *Staminate flowers* 1.5–3.7 mm diam., glabrous; pedicel 3.5–6 mm long, glabrous to with asperities; calyx 1–1.7 mm deep, lobes heart-shaped, 0.7–1.2 by 0.8–1.6, apex rounded to emarginate to c. 1/3rd of lobe length, glabrous; stamens glabrous: androphore c. 0.3 mm long, anthers c. 0.3

by 0.3 mm. *Pistillate flowers* 2.7–5.3 mm diam.; pedicel 1.5–4.3 mm long, glabrous to hairy; calyx lobes 1.2–2.5 by 1.5–2.2 mm, apex spade-like to rounded, glabrous to hairy outside, glabrous inside; ovary c. 1 by 1.7 mm; stigmas (seldom horizontal to) erect, c. 1 mm long, upper c. 0.5 mm curled for more than a complete circle. *Fruits* ovoid, 5–5.5 by c. 4 mm, broader than high, apically with raised, lobed rim around stigmas; column c. 2 mm long, tapering towards apex. *Seeds* triangular in transverse section, c. 3.5 by 2 by 2 mm.

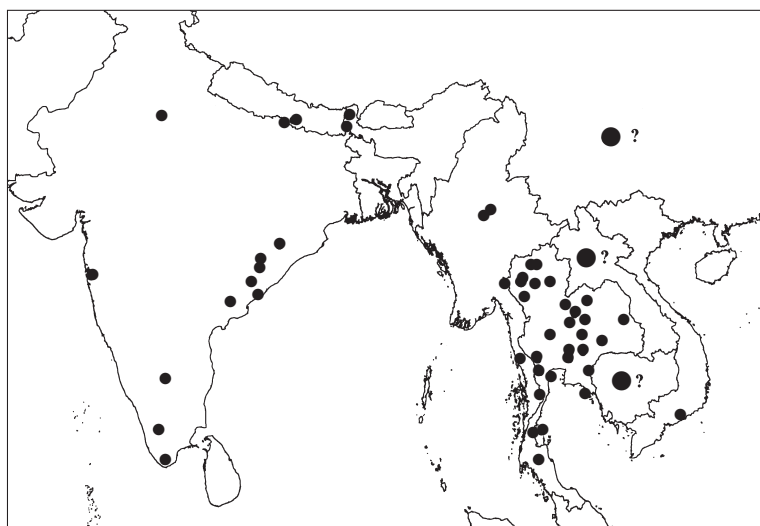
**Distribution** — India, Nepal, China (Yunnan), Myanmar, Thailand, Laos, Cambodia, Vietnam.

**Habitat & Ecology** — Usually in strongly disturbed places in deciduous scrub, (dry) evergreen forest, dry dipterocarp(-pine) forest, (bamboo-)deciduous forest, often in open, (regularly burned and/or grazed) grassy or rocky places, rocky dipterocarp savannah, dense bamboo thickets, in limestone crevices, sometimes common along streams, margins of forest, along roads, places often fire prone; soil: sand, loam, laterite, rocks with granite, once recorded from silty soil; limestone, shale or sandstone bedrock. Altitude 5–2100 m. Flowering: April to October; fruiting: July to September.

**Vernacular names** — Thailand: Makham pom din, mayom kliang, mayom lamun, mayom thuean (official Thai name).

**Notes** — 1. Roxburgh (1832) clearly refers to *Phyllanthus rhamnoides* of Willdenow. He definitely misinterpreted Willdenow's description and did not describe a new species. Therefore, the first author to describe (or refer to Roxburgh's description) is Wight (1852) and the author reference should be Roxb. ex Wight.

2. The two names used for the hairy specimens (*S. quadrangularis* var. *puberulus* and *S. pubescens*) are often erroneously considered to be homotypic due to their resemblance. However, Hooker (1887), the author of the second name, treats them as two different entities (Kurz's name is treated under *S. quadrangularis* by Hooker).



Map 15. Distribution of *Sauropus quadrangularis* (Willd.) Müll.Arg.

3. *Sauropus quadrangularis* strongly resembles all other small-leaved Thai species. The most distinctive character is the erect stigmas (horizontal in all other species), which are not crescent-moon shaped, but fountain-like (erect and apically splitting into two stigma lobes). The stigmas are surrounded, especially in fruit, by a lobed rim of the ovary (stigmas in a depression like in some *Breynia* species).

4. Three varieties were described: *compressus*, *puberulus*, and *quadrangularis*. The differences between the varieties are only slight, and it is often a matter of taste under which name specimens are identified. Seemingly, the so-called varieties also grow together (see remark of Airy Shaw, 1972). Therefore, all varieties are united. The species is variable: The degree of hairiness varies between glabrous to densely hirsute, also the compression of the branches varies between almost flat to four-cornered. Furthermore, the thickness of the leaves is very variable and the colour of the flowers varies between red and usually yellow. Also variable is the size and especially the apical indentation of the staminate sepal lobes, the apex can vary between rounded to V-shaped.

5. Specimens in India (Tamil Nadu) may have very narrow sepal lobes.

6. See note under *S. asteranthos*, under *S. brevipes*, and note 3 under *S. orbicularis*.

## 22. *Sauropus rhamnoides* Blume — Fig. 1b, c, 3a, 8; Map 16

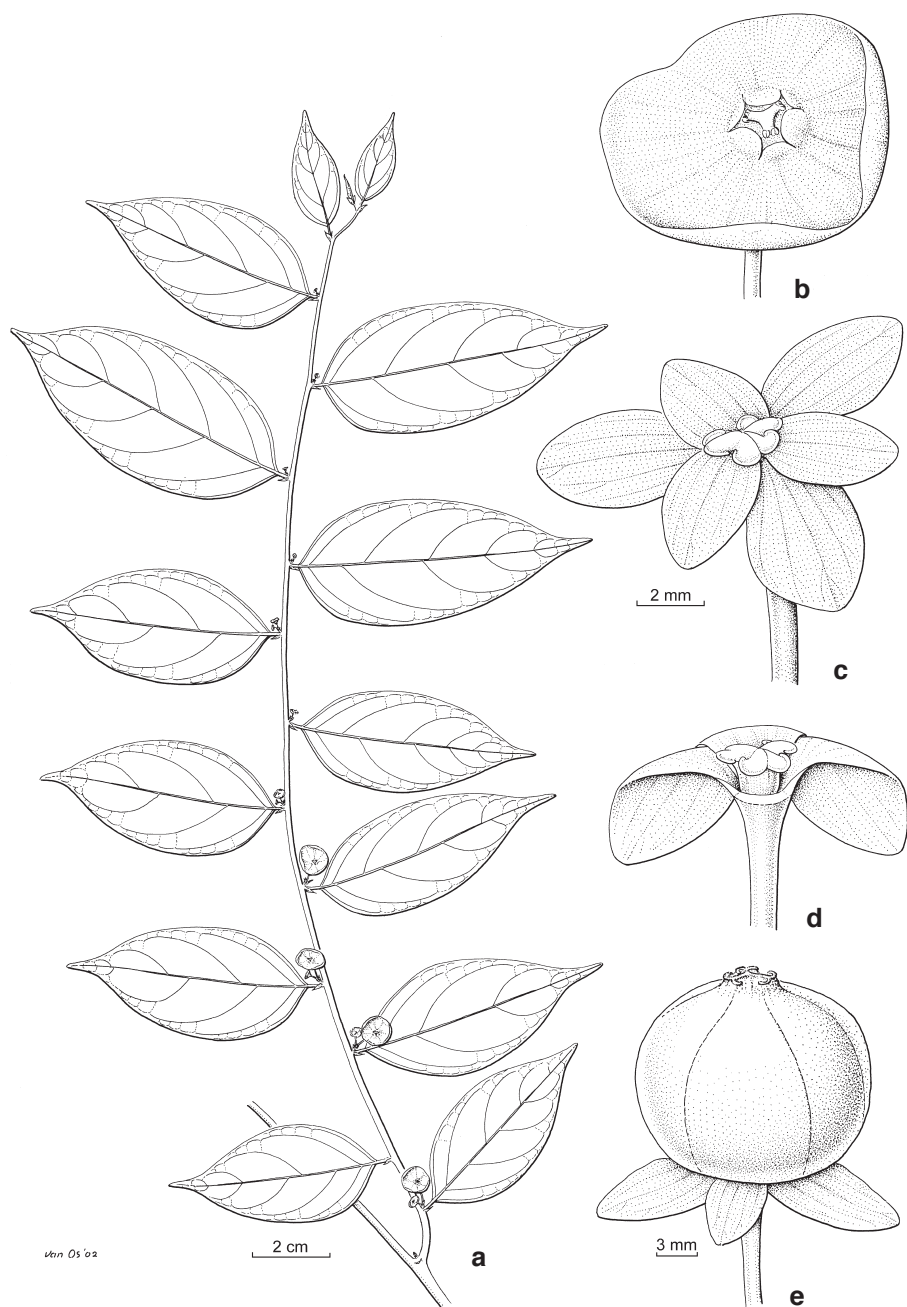
*Sauropus rhamnoides* Blume (1825) 596; Müll. Arg. (1866) 240; J.J. Sm. (1910) 191; Merr. (1921) 329; Pax & K. Hoffm. (1922) 219; S. Moore (1925) 93; Merr. (1929) 139; Backer & Bakh.f. (1964) 471; Airy Shaw (1975) 194; (1977) 81; Chakrab. & M.G. Gangop. (1996) 539, f. 11; Smitinand (2001) 468. — *Aalius rhamnoides* (Blume) Kuntze (1891) 591, 'rhamnoides'. — Lectotype (proposed here): *Blume s.n.* (L, barcode L0138511), Indonesia, Java, Montis Salak.

*Sauropus lanceolatus* Hook.f. (1887) 333. — Type: *Griffith KD 4825* (K; '4828' on sheet), India, East Bengal, Mishmee. (NB. There are more sheets of *Griffith KD 4828* in K, one is a paratype of *S. macrophyllus* Hook.f.)

*Sauropus hayatae* Beille (1927) 650. — Type: *Hayata s.n.* (holo P), Vietnam, Annam, Bum-mo.

*Sauropus rostratus* auct. non Miq.: Airy Shaw (1982) 35.

Herbs to (scandent) shrubs to treelets to small vines, up to 6(–10) m high, dbh up to 4(–12) cm; young branches with 2 or 4 ribs, flowering branches 0.8–2 mm thick. *Indumentum* absent. *Stipules* triangular, 2–3.5 by 0.8–1.5 mm, basally usually eared, usually thin with membranous margin, usually caducous, sometimes thorn-like. *Leaves*: petiole 3–4 mm long, flattened and grooved along midrib above; blade ovate (to elliptic), 2.2–17.2 by 1–8.4 cm, length/width ratio 1.2–3.2, papery, base cuneate to somewhat oblique, margin flat to recurved, apex (gradually to) suddenly smaller with 2 sinuses, acuminate to cuspidate (see notes 2 and 3), often mucronulate, dark green above, pale light green, usually not papillate underneath; venation well-visible on both sides, nerves 7–10 per side, veins somewhat scalariform, veinlets reticulate. *Inflorescences* axillary fascicles, sometimes short staminate racemes of up to 5 mm long, flowers usually single or few together, usually all of same sex. *Staminate flowers* 4.5–19(–25, Philippines) mm diam.; pedicel 6.2–12 mm long, green to white; calyx not or hardly lobed and circular (to lobed and more star-shaped in SE Thailand and the Lesser Sunda Islands, or sometimes deeply lobed in the Philippines; see notes 2 and 3), white to striped pinkish or striped reddish to reddish, lobes 1–1.6 by 1.5–2.5 mm, somewhat leathery,





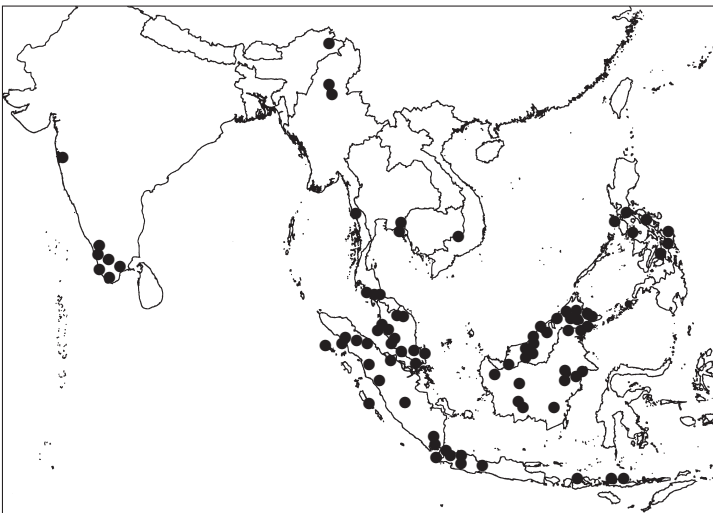
apex entire; stamens: androphore 0.1–0.4 mm long, anthers 0.3–0.5 by 0.3–0.4 mm, blackish. *Pistillate flowers* 6.5–27 mm diam.; pedicel 7.5–20 mm long, apically 1–1.5 mm thick, very pale greenish; calyx lobes thick, only at very base attached, obovate, yellowish or light green to red, smaller inner ones (4–)6–10 by (3.3–)6–8 mm, larger outer ones (4–)7–16 by (4–)7–11 mm; pistil light yellow to whitish, ovary bell-shaped, 1.8–3.6 by 1.5–2.7 mm; stigmas 1.3–2.3 mm long, horizontal, thick, upper half curved, forming more than a complete circle. *Fruits* ellipsoid to obovoid, inflated, somewhat fleshy but pergamentaceous when dry, 13–31 by 13–23 mm, white to pale yellow to finally red, somewhat higher than broad, wall thin except near sutures; column 17–19 mm long, in upper 2/3rd with heart-shaped remnants of septae. *Seeds* triangular in section, hollow adaxially, c. 11 by 6–7 by 4–5.5 mm, blackish.

**Distribution** — India, Myanmar, Thailand (South-eastern and Peninsular floristic districts), Cambodia, S Vietnam, Malay Peninsula, Sumatra, Java, Borneo, Philippines, Lesser Sunda Islands (Sumbawa, Flores).

**Habitat & Ecology** — Evergreen forest, mixed dipterocarp forest, lower montane forest, secondary forest to open vegetations, along rivers or forest edges, swamp forest edges, ladang edges, also as village hedge; terrain level to hilly to mountainous; soil: rich in clay, sometimes black in colour, sometimes rocky, sometimes covered with guano, andesite; bedrock: basalt, granite, limestone. Altitude 5–1750 m. Flowering and fruiting throughout the year.

**Uses** — The fruits are edible and the leaves are sometimes used as vegetable.

**Vernacular name** — Thailand: Mayom liam. Malay Peninsula: Asing asing hutan. Sumatra: Alor anteu anteu, katoei. Java: Djiendjieng (Javanese); katoek-badak, katoek endog, telor kotok (Sundanese) (Smith, 1910; Moore, 1925). Borneo: Kalimantan: Kabo, oroh mi(h), rangkok rimba; Sabah: Obah (Malay); Sarawak: Changkok manis (hutan) (Malay). Lesser Sunda Islands: Mintje, tago potjo (Flores).



Map 16. Distribution of *Sauropus rhamnoides* Blume.

Notes — 1. Airy Shaw (1977) tentatively added Thailand to the distribution of *S. rhamnoides*, which was correct. All specimens of SE and Peninsular Thailand, formerly referred to *S. garrettii*, appeared to be *S. rhamnoides* (see note under *S. garrettii* for differences). The Malay Peninsular appeared to be a gap in the distribution of *S. rhamnoides*, but here also, the species was not recognised properly, it was mixed with *S. androgynus* (for differences see note under *S. androgynus*).

2. *Sauropus rhamnoides* is also present in India and Myanmar, but difficult to separate from *S. androgynus*. The leaves are generally somewhat larger, have a sinuous and sharper apex. The staminate flowers, pistillate calyx lobes and fruits are not so much larger than those of *S. androgynus*. *Sauropus rhamnoides* in India is recognised under many different names: a paratype of *S. macrophyllus*, *S. lanceolatus*, *S. androgynus*, and *S. garrettii*.

3. The specimens from SE Thailand are somewhat different in that the staminate flowers have a distinctly lobed, hardly spreading calyx. The same syndrome can be found on the Lesser Sunda Islands and more extremely so in the Philippines (see next note).

4. The Philippine specimens of *S. rhamnoides* are very similar to those of *S. androgynus* (much smaller leaves), because *S. rhamnoides* lacks its distinct subapical, laminar sinuses (apex gradually cuspidate). The same can be observed on the Lesser Sunda Islands. However, the very apex remains much sharper than in *S. androgynus*. The staminate flowers of *S. rhamnoides* in the Philippines can become very large, up to 25 mm diam., which is much larger than those of *S. androgynus* (up to 6 mm diam.), or they become deeply divided. The specimens with the deeply divided staminate flowers are very exceptional, they are found on Samar (*BS 24500*), Leyte (*Wenzel 370, 1583*), and in the Camarines Sur Province on Luzon (*Ahern 288*). One Philippine specimen of *S. androgynus* (*BS 26491*) shows the same phenomenon of a deeply divided staminate calyx (like the Sri Lankan *S. assimilis* Thwaites, the Indian *S. trinervius* Müll.Arg., and the Bornean *S. micrasterias*).

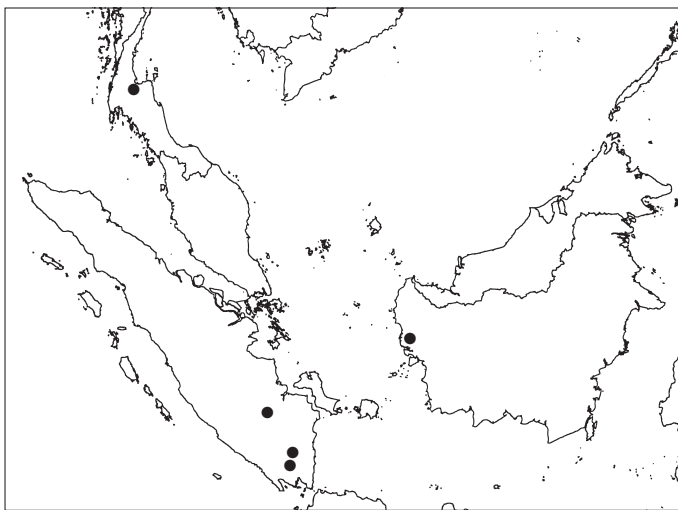
5. For differences between *S. rhamnoides* and *S. macranthus* see note under latter.

### 23. *Sauropus rostratus* Miq. — Map 17

*Sauropus rostratus* Miq. (1860) 179, 447; Müll.Arg. (1866) 243; Pax & K. Hoffm. (1922) 225; Airy Shaw (1969) 55; (1981) 343. — *Aalius rostratus* (Miq.) Kuntze (1891) 591, 'rostrata'. — Lectotype (selected here): *Teijsmann HB 3678* (holo U), Sumatra, Palembang Prov., River Lamatang near Koeripan (Kuripan).

*Sauropus temii* Welzen & Chayamarit [ex Smitinand (July 2001) 468, nom. nud.] (Oct. 2001) 654. — Type: *Smitinand 2877* (BKF), Thailand, Peninsular, Surat Thani, Bang Bao. See note 2.

Shrub, up to at least 60 cm tall; young branches with 2 broad rims and sometimes 2 additional vague ones, many asperities between and on rims, flowering branches 0.8–1 mm thick. *Indumentum* absent. *Stipules* triangular, 1–2.2 by 0.7–1.2 mm, often basally eared, stiff, rather persistent. *Leaves*: petiole 1.3–2 mm long, with asperities, somewhat flattened above; blade ovate (to elliptic), 2.9–7 by 0.9–2.6 cm, length/width ratio 1.9–3.2, chartaceous, base broadly cuneate, margin flat to revolute, apex gradually acute, mucronulate, drying greyish above, brownish or greenish below, not distinctly papillate, venation indistinct, midrib sharply raised above, nerves 7–9 per side, basal

Map 17. Distribution of *Sauropus rostratus* Miq.

one ending far below middle, veins and veinlets indistinct, reticulate. *Inflorescences* axillary fascicles or in short staminate racemes, less than 5 mm long; flowers single or in small groups, both sexes at same time, green. *Staminate flowers* 2–2.5 mm diam.; pedicel 1.2–2 mm long; calyx lobes without scales, rather small, cupular, 3 lobes folded inwards and apex grown together with raised midrib, 0.5–0.7 by 1.2–1.5 mm, other 3 lobes with incurved apex, 0.5–0.7 by 0.3–0.7 mm; stamens: androphore c. 0.7 mm long, anthers erect, c. 1 by 0.8 mm. *Pistillate flowers* 2.5–5 (–8 in fruit) mm diam.; pedicel 1–2 mm long; calyx cupular, hardly lobed, smaller three lobes 0.5–2 by 1–3 mm, larger three lobes 0.8–2.7 by 1.5–5.5 mm, apex spade-like; ovary bell-shaped with flat apex on which 3 rims between stigmas, 1–1.5 by 1.2–2 mm; stigmas 1–1.4 mm long, split in upper 0.5–0.6 mm, recurved. *Fruits* ellipsoid, wider than high, c. 6 by 3.7 mm; column broadly triangular, c. 0.5 mm high. *Seeds* triangular in transverse section, half-moon-shaped, c. 3.3 by 2.4 by 2.8 mm.

Distribution — Thailand (Peninsular floristic district), Sumatra, Borneo.

Habitat & Ecology — Scattered in evergreen forest. Altitude under 100 m. Flowering: August.

Vernacular name — Thailand: Mak bang bao.

Notes — 1. The specimens from the Lesser Sunda Islands, as mentioned by Airy Shaw (1982), are certainly not *S. rostratus*, but an atypical form of *S. rhamnoides*. They have a very different type of staminate flower (the normal *Sauropus* stamens: low androphore, 3 horizontally spreading branches with anthers underneath) and much larger fruits (up to 2 cm diameter).

2. *Smitinand* 2877 (BKF) from Thailand was originally selected as a new species. It is a very scrappy specimen but easily recognisable as a distinct entity. However, extension of the revisions of *Sauropus* to the complete Malesian area showed it to be similar to *S. rostratus*.

**24. *Sauropus shawii* Welzen, *spec. nov.* — Map 4**

Folia basi asymmetrica infra cinereo-viridia in sicco, venatione indistincta. Flores staminati calycis lobis tribus apice inflexo, tribus ceteris apice involuto ipso connato (grex *Hemisauropus*). Fructus pericarpio crasso suberoso inter stigmata apertura apicali gerens.

— Typus: *P.F. Stevens et al.* 513 (holo L; iso A, KEP), Malaysia, Sabah, Lahad Datu, Ulu Sungei Segamat, 16 Jan. 1976.

*Sauropus pierrei* auct. non (Beille) Croizat: Airy Shaw (1975) 194. See note 4.

Treelet up to 2.1 m high, bole up to 1.2 m high, dbh up to 2.5 cm; branches horizontal, flowering branches 2.5–3 mm thick, youngest branches with 2 ridges. *Indumentum* absent. *Outer bark* smooth, grey, soft, c. 1 mm thick; inner bark grey and yellow, soft, fibrous. *Stipules* triangular, basally strongly narrowing into a awn-like extension, 1.4–2 by 1–1.5 mm, rather persistent. *Leaves*: petiole c. 3 mm long, flattened above; blade ovate, 6.8–11.2 by 3.8–4.9 cm, length/width ratio 1.8–2.3, papery, base cuneate, strongly asymmetric, margin flat, apex acuminate to cuspidate, mucronulate, upper surface dark shiny green, lower surface paler, shortly and densely papillate; venation hardly distinct on both sides, nerves 6 or 7 per side, veins  $\pm$  scalariform, veinlets indistinct. *Inflorescences* axillary fascicles, staminate flowers sometimes in short, up to 2 mm long, racemes. *Staminate flowers* c. 2.5 mm diam.; pedicel c. 3.5 mm long; calyx lobed till halfway, obovate, 3 smaller, outer lobes c. 1 by 1–1.2 mm, apex incurved, rounded; 3 inner, larger lobes 0.7–0.8 by 1.5–1.7 mm, apex incurved and grown with blade; stamens erect, androphore c. 0.2 mm long, anthers c. 1.3 by 1 mm. *Pistillate flowers* unknown; pedicel in fruit 8–13 mm long; calyx cupular, 9–11 mm deep in fruit, lobes obovate, 5–6 by 5–6 mm, apex spade-like; stigmas free from each other, c. 1.2 mm long, erect, split in upper half, apices recurved for less than a full circle. *Fruits* ovoid, wider than high, 15–16 by 17–19 mm; wall thick, up to 2.5 mm; apically a hole between stigmas. *Seeds* triangular in transverse section, half-moon-shaped, c. 5 by 3.5 by 3.3 mm.

Distribution — Borneo (Sabah: Tawau & Lahad Datu District).

Habitat & Ecology — Primary forest, once recorded near river. Altitude 170–500 m. Flowering: January; fruiting: February to April.

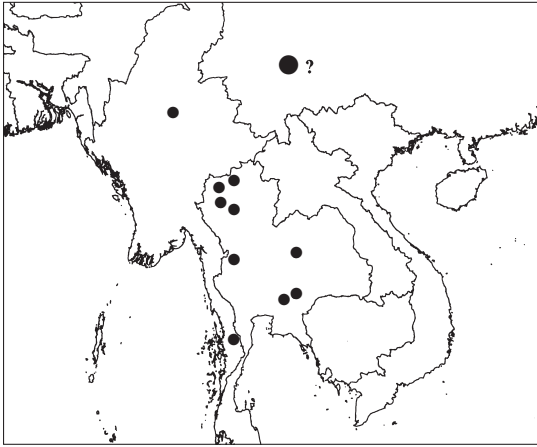
Notes — 1. This entity resembles *S. rhamnoides* in leaf shape and size, but the leaves are basally asymmetric, the venation is indistinct and the lower surface is very glaucous. *Sauropus shawii* clearly belongs to the *Hemisauropus* group, but it is unlike the other species in this group in several respects. The strongest resemblance is with *S. pierrei* (different in leaf size, but just as asymmetric), *S. subterblancus* (different in the more cuspidate apex, asymmetry, and leaf size), and *S. rostratus* (larger leaves, lack of asperities).

2. The name is in honour of H.K. Airy Shaw, who described and revised most Malaysian Euphorbiaceae and who was the first to note that two SAN collections from Borneo represented something new (Airy Shaw, 1975, under *S. pierrei*).

3. See note under *S. asymmetricus*.

**25. *Sauropus similis* Craib — Map 18**

*Sauropus similis* Craib (1911) 457; Pax & K. Hoffm. (1922) 225; Airy Shaw (1969) 46; (1972) 338; Smitinand (2001) 468. — Lectotype (selected here): *Kerr* 1788 (holo K; iso BM), Thailand, Chiang Mai, Doi Sutep.



Map 18. Distribution of *Sauropus similis* Craib.

(Under)shrubs, up to 3 m high; branches with 4 ribs, often with rows of small asperities along them, flowering branches 0.7–1 mm thick. *Indumentum* absent. *Stipules* triangular to falcate, 1–1.5 by 0.4–1.7 mm, often basally eared, rather persistent. *Leaves*: petiole 1.2–2 mm long, somewhat grooved above; blade ovate (to elliptic), 0.7–3.7(–5.8) by 0.5–2(–2.9) cm, length/width ratio 1.4–2, (papery to) chartaceous, base emarginate to cuneate, margin flat to revolute, on upper surface with c. 1 mm wide band of small asperities, apex rounded, mucronulate, upper surface dark green with lighter venation, lower surface light green; venation rather indistinct, midrib and nerves visible above, some veins below, midrib often with small asperities; nerves 5–8 per side, veins reticulate. *Inflorescences* axillary fascicles, flowers usually single (pistillate or staminate) or few together (staminate); flowers green to red. *Staminate flowers* 4.2–4.5 mm diam.; pedicel 4.9–6 mm long; calyx c. 2 mm deep, lobes 0.4–0.7(–1.2) by (1–)1.6–2.3 mm, apex entire, rounded; stamens: androphore c. 0.2 mm high, anthers c. 0.3 by 0.6 mm. *Pistillate flowers* 3.6–8.2(–12.5 in fruit) mm diam.; pedicel 1.5–3.7 mm long; calyx lobes spade-like, 1–2.1 by 1–3.3(–6 in fruit) mm, free for greater part; ovary 0.5–0.7 by 1.3–2 mm; stigmas horizontal, up to 1 mm long, cleft till halfway, coiled in a full or more than a full circle. *Fruits* ovoid, c. 5.5 by 3.5–4.2 mm, apically with low rim; column 1.2–1.7 mm long, tapering towards apex. *Seeds* triangular in transverse section, 3–3.3 by 2.1–2.3 by 2.4–2.6 mm.

Distribution — China (Yunnan), Upper Myanmar, Thailand (Northern, Eastern, Central, and South-eastern floristic provinces).

Habitat & Ecology — Dry evergreen forest, deciduous oak forest, often in very disturbed, usually fire-prone places like sunny roadsides, open grassland, among bamboo, along streams; soil: clayey; granite, limestone or shale bedrock. Altitude 100–1800 m. Flowering: June to December; fruiting: September.

Vernacular name — Thailand: Mayom lamai.

## 26. *Sauropus spatulifolius* Beille

*Sauropus spatulifolius* Beille (1927) 652, '*spatulaefolius*'; Airy Shaw (1979) 531, '*spatuliifolius*'; Smitinand (2001) 468, '*spatuliifolius*'. — Type: *Bon 9130* (holo P), Vietnam, Tonkin, Lang-nhoi.

*Sauropus changianus* S.Y. Hu (1951) 393, pl. 1: 12–15, 'changiana'. — Type: *F.C. Chang s.n.* (holo A), China, Kwangtung, 1950.

Woody herbs to small shrubs, somewhat succulent, up to c. 40 cm high; often branching on ground, branches decumbent, grey-greenish; rootstock woody, stoloniferous; branches without ribs, flowering twigs c. 2.2 mm thick, with small asperities. *Indumentum* absent. *Stipules* triangular, 3–6 by 3–4 mm, pergamentaceous, basally eared, persistent. *Leaves*: petiole 2–4.5 mm long, flattened above, pulvinate, with small asperities above; blade obovate, 7–13 by 2.2–4.6 cm, length/width ratio 2.5–3.5, pergamentaceous, base rounded, margin flat with some small asperities, apex emarginate with long mucron, curving from lower surface upwards, midrib often with asperities, upper surface mottled dark green and greenish or green with silvery areas along midrib and veins, lower surface not papillate, evenly light green; venation raised on both sides, nerves 9–11 per side, veins and veinlets reticulate, rather indistinct. *Inflorescences* ramiflorous, short, branching racemes up to 10 mm long; flowers in small groups or single, dark red or maroon. *Staminate flowers* 3.3–4.5 mm diam.; pedicel 4–5.5 mm long; calyx lobes free in upper half, triangular to strap-like, 1–1.3 by 1–1.4 mm, apex entire, rounded; stamens: androphore c. 0.3 mm long, anthers c. 0.3 by 0.3 mm. *Pistillate flowers* 4–6 mm diam.; pedicel 0.3–1 mm long; sepals free, obovate, spatulate, clawed, 2–2.5 by 1.2–1.8 mm, thick, claw c. 0.6 mm long; ovary bell-shaped, c. 0.8 by 0.7–0.8 mm, stigmas horizontal, up to 0.7 mm long, split till halfway, curled in more than a complete circle. *Fruits* globose, c. 7 by 5.5 mm, very wrinkled when dry; column not seen. *Seeds* not seen.

Distribution — Perhaps naturally occurring in S China and Vietnam, introduced in Hong Kong, Thailand (Chiang Mai, Bangkok), and Hawaii (Oahu).

Habitat & Ecology — Easily cultivated in botanical and herbal gardens. Altitude 300 m.

Uses — Used in Chinese medicine (a broth from leaves and branches is drunk for a sore throat and cough; *N. Wong s.n.*), and perhaps also cultivated for its fragrant flowers like *S. thorelii* (Airy Shaw, 1979).

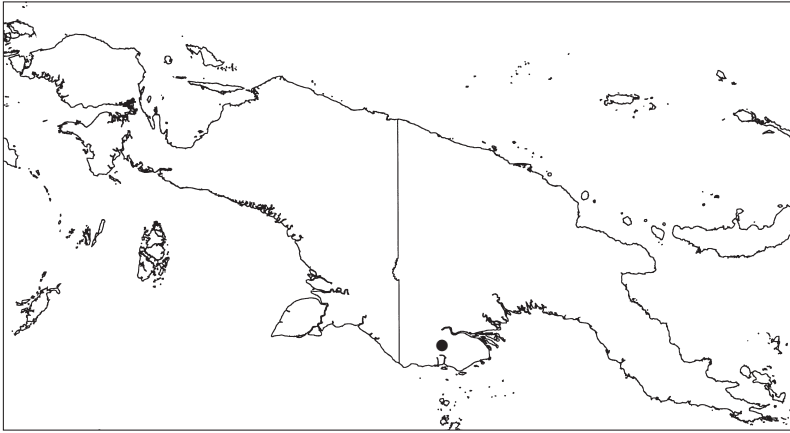
Vernacular names — China: Lung-li-yah. Thailand: A-che-chao (Chinese); mayom bai phai (official Thai name).

Note — Very distinct species with its ramiflorous flowers, very large stiff stipules, free, spatulate pistillate sepals, and globose, wrinkled fruits.

## 27. *Sauropus sphenophyllus* (Airy Shaw) Airy Shaw — Map 19

*Sauropus sphenophyllus* (Airy Shaw) Airy Shaw (1980a) 221; (1980b) 686. — *Synostemon sphenophyllus* Airy Shaw (1978) 37; (1980a) 205. — Type: *NGF (Henty & Katik) 38763* (holo BRI; iso L), Papua New Guinea, Western Prov., Morehead Subprov., Sibidiri, Mai Kussa River, 142.15 E, 8.59 S.

Shrub, up to 1.5 m tall; branches with 2 small ribs, with asperities when young, flowering branches 0.2–0.3 mm thick. *Indumentum* absent. *Stipules* triangular, 0.8–1.2 by 0.5–0.6 mm, pergamentaceous, whitish-yellowish when dry except for the base, rather persistent. *Leaves*: petiole 0.5–1 mm long, flattened above; blade obovate, 1–2.8(–4) by 0.7–1.1 cm, length/width ratio 1.4–3.6, pergamentaceous, base cuneate, margin recurved, apex emarginate to rounded, mucronulate, upper surface green when dry, lower surface lighter green, papillate; venation raised and distinct on both sides, nerves



Map 19. Distribution of *Sauropus sphenophyllus* (Airy Shaw) Airy Shaw.

6–9 per side, veins and veinlets reticulate. *Inflorescences* axillary fascicles; flowers usually solitary, yellowish. *Staminate flowers* c. 3 mm diam.; pedicel c. 4 mm long; calyx c. 1.2 mm deep, lobes almost free, obovate, 1–1.1 by 0.7–1.2 mm, apex rounded, scales lacking; stamens of *Glochidion*-type: androphore c. 1.3 mm long, basal part c. 0.5 mm long, apically not split into horizontal branches but erect, anthers c. 0.8 by 0.3 mm, along androphore, elongation of connective c. 0.2 mm long. *Pistillate flowers* c. 4.5 mm diam.; pedicel c. 6.5 mm long; calyx lobes obovate, 2.2–2.5 by 0.8–1.1 mm, apex rounded; ovary obtrapezoid, c. 1 by 1.2 mm, apically forming three cushions around the subapical stigmas; stigmas c. 1 mm long, erect, free, apically not split but slightly bent. *Fruits* not seen.

Distribution — Endemic to Papua New Guinea (Western Province).

Habitat & Ecology — Woodland on low hill. Altitude 150 m. Flowering and fruiting: July.

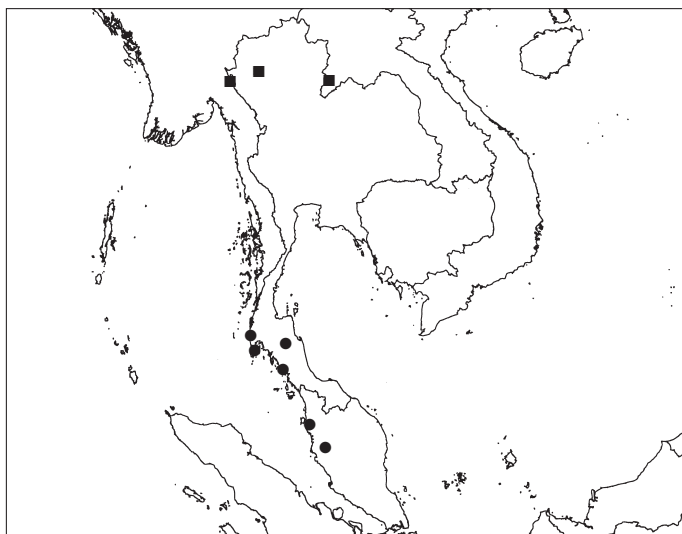
Notes — 1. According to Airy Shaw (1978, 1980a) strongly resembling *S. albiflorus* (F. Muell. ex Müll. Arg.) Airy Shaw of eastern Queensland. The latter species has less cuneate, smaller leaves which are seemingly more glaucous; the branches lack the asperities.

2. *Sauropus sphenophyllus*, like *S. bacciformis*, belonged to the former genus *Synostemon*. This group apparently forms a transition between *Sauropus* and *Breynia* and *Glochidion*. *Sauropus bacciformis* shows the typical *Sauropus* stamens, while *S. sphenophyllus* shows typical *Glochidion* stamens. It is questionable whether *S. sphenophyllus* should be maintained in *Sauropus* (the stigmas are also much more like those in *Breynia*). A cladistic analysis, including molecular data, should clarify this matter.

## 28. *Sauropus suberosus* Airy Shaw — Map 20

*Sauropus suberosus* Airy Shaw (1969) 42; (1971) 500; (1972) 338; Whitmore (1973) 130; Smitinand (2001) 468. — Type: Hansen & Smitinand 12030 (holo K; iso L, SING), Thailand, Peninsular, Phuket, Khao Thong Lang, NW of Nai Chong.





Map 20. Distribution of *Sauropus suberosus* Airy Shaw (●) and *S. thorelii* Beille (■).

Shrubs, up to 4 m high, simply branched; stems at most with indistinct ribs when very young, sometimes with small asperities, older branches with a thick, longitudinally fissured, soft, brown cork. *Indumentum* simple hairs only, glabrous except for inflorescences. *Stipules* triangular, 3.5–6 by 1.2–4 mm, basally eared, very thick, stiff, easily breaking off, otherwise persistent, margin light coloured. *Leaves*: petiole 2–4 mm long, flattened dorsiventrally, especially above, sometimes minute asperities; blade elliptic to obovate, 7.7–25 by 2.6–7.3 cm, length/width ratio 3–3.6, papery, base cuneate, margin flat to revolute, apex acute to cuspidate, often mucronulate, venation relatively distinct on both sides, nerves 12 or 13 per side, veins and veinlets reticulate. *Inflorescences* racemes, cauliflorous in basal part of stem, sometimes over ground, up to 41 cm long, slightly hairy, 4-ribbed or somewhat flattened, rachis dark reddish, with groups of flowers of which one or two pistillate; flowers pink, dark reddish, dark purplish or yellowish. *Staminate flowers* 3.7–4 mm diam.; pedicel up to 5.5 mm long; calyx lobes 0.8–1 by 1–1.6 mm, up to one third of calyx height, rounded, often folded inward; stamens: androphore c. 0.2 mm long, anthers 0.4–0.5 by 0.4–0.5 mm. *Pistillate flowers* 4.3–7.7 mm diam.; pedicel 2.5–4.5 mm long, glabrous to hairy; calyx lobes thick, mostly obovate, three smaller outer ones 1.2–2.5 by 2.1–4 mm, inner larger ones 1.5–3 by 2–4.2 mm; ovary 1.1–1.8 by 1.1–2 mm; stigmas 1–1.3 mm long, horizontal, split in upper half, forming more than a complete circle. *Fruits* unknown.

Distribution — Thailand (Peninsular floristic district) and Peninsular Malaysia (Perak).

Habitat & Ecology — Thickets in moist, evergreen forest on mountain ridge; soil: limestone, rocky with a fair amount of accumulated soil. Altitude 80–800 m. Flowering: November to January.

Vernacular name — Thailand: Mayom yak.

**29. *Sauropus subterblancus* (C.E.C. Fisch.) Welzen — Map 14**

*Sauropus subterblancus* (C.E.C. Fisch.) Welzen (2001) 504. — *Glochidion subterblancum* C.E.C. Fisch. (1927) 211. — *Breynia subterblancum* (C.E.C. Fisch.) C.E.C. Fisch. (1939) 98. — Type: C.E. Parkinson 1669 (holo K; iso K), Myanmar (Burma) South Tenasserim, Kyein Chaung.

Low shrubs, up to 70 cm high; only very young branches with 2 ribs; flowering branches 1–1.3 mm thick. *Indumentum* absent. *Stipules* triangular, 1.3–1.4 by 0.9–1 mm, basally eared, stiff, rather persistent. *Leaves*: petiole 2–2.5 mm long, pulvinate, ridged above, some asperities above; blade ovate, 3.5–7.5 by 2–4.1 cm, length/width ratio 1.7–1.9, coriaceous, base attenuate, margin somewhat revolute, apex acute, mucronulate, glaucous when dry, papillate below; venation indistinct above and beneath, nerves 6–8 per side, veins and veinlets reticulate. *Inflorescences* axillary fascicles with single flowers, staminate ones lower on the branches; flowers pale green. *Staminate flowers* c. 3.5 mm diam.; pedicel c. 2 mm long; calyx c. 1.7 mm high, smaller sepals c. 1 by 2 mm, apex rounded, involute, larger ones c. 1 by 1.3 mm, emarginate, apex inflexed and grown with blade; stamens: androphore c. 1 mm long, yellow, anthers c. 1.2 by 1.2 mm. *Pistillate flowers* 5(–10.5 in fruit) mm diam.; pedicel 2.5–3 mm; calyx lobes obovate, rounded, small ones c. 2 by 1.1 (to 2 by 3 in fruit) mm, larger ones c. 2.3 by 1.3 (to 2 by 6 in fruit) mm; ovary not measured; stigmas erect, c. 2 mm long, split in upper half, somewhat coiled, papillate above, with basal to each stigma two fleshy, erect ovary lobes. *Fruits* ovoid, c. 7 by 5 mm, apically with rim formed by thickened apical ovary lobes; column not seen. *Seeds* not seen.

Distribution — Myanmar (S Tenasserim) and Thailand (Peninsular district: Ranong Province).

Habitat & Ecology — Evergreen forest. Altitude 50–70 m. Flowering and fruiting: February.

Vernacular names — Myanmar: Kyanna (Burmese); thakwan (Shan).

Note — *Sauropus subterblancus* has been mistaken for a *Breynia* and a *Glochidion*, but clearly belongs to the *Hemisauiropus* group in *Sauropus* (3 large, almost erect stamens, inner staminate sepals inflexed with apex grown together with rest of blade, and fleshy extensions of the ovary next to the stigmas, erect stigmas which are hardly coiled and clearly papillate above).

**30. *Sauropus thorelii* Beille — Map 20**

*Sauropus thorelii* Beille (1927) 649, f. 76: 6–14; Smitinand (1955) 14; Airy Shaw (1972) 338; Smitinand (2001) 468. — Type: *Thorel* 3227 (holo P; iso K), Laos, Pak-lay, Lakhone.

Shrubs, up to 1.5 m high; young branches with 2 or 4 ribs; flowering branches 4–7 mm thick. *Indumentum* absent. *Stipules* triangular, 1.5–3 by 0.5–1.2 mm, stiff, basally eared, persistent. *Leaves*: petiole 2–2.3 mm long, flattened above, with 3 indistinct longitudinal ridges and very indistinct asperities; blades ovate to elliptic, 2.6–10.1 by 1.2–3 cm, length/width ratio 2.2–5.3, papery, base cuneate, descending, margin flat to somewhat revolute, apex acute (to acuminate), mucronulate; venation mainly distinct beneath, nerves (6–)10–14 per side, veins and veinlets reticulate. *Inflorescences* ramiflorous, up to 2 cm long panicles (raceme-like with very short, up to 3 mm long branches), per branch several staminate and a single pistillate flower, each flower single per bract. *Flowers* red, strongly scented. *Staminate flowers* 4–7.5 mm diam.; pedicel

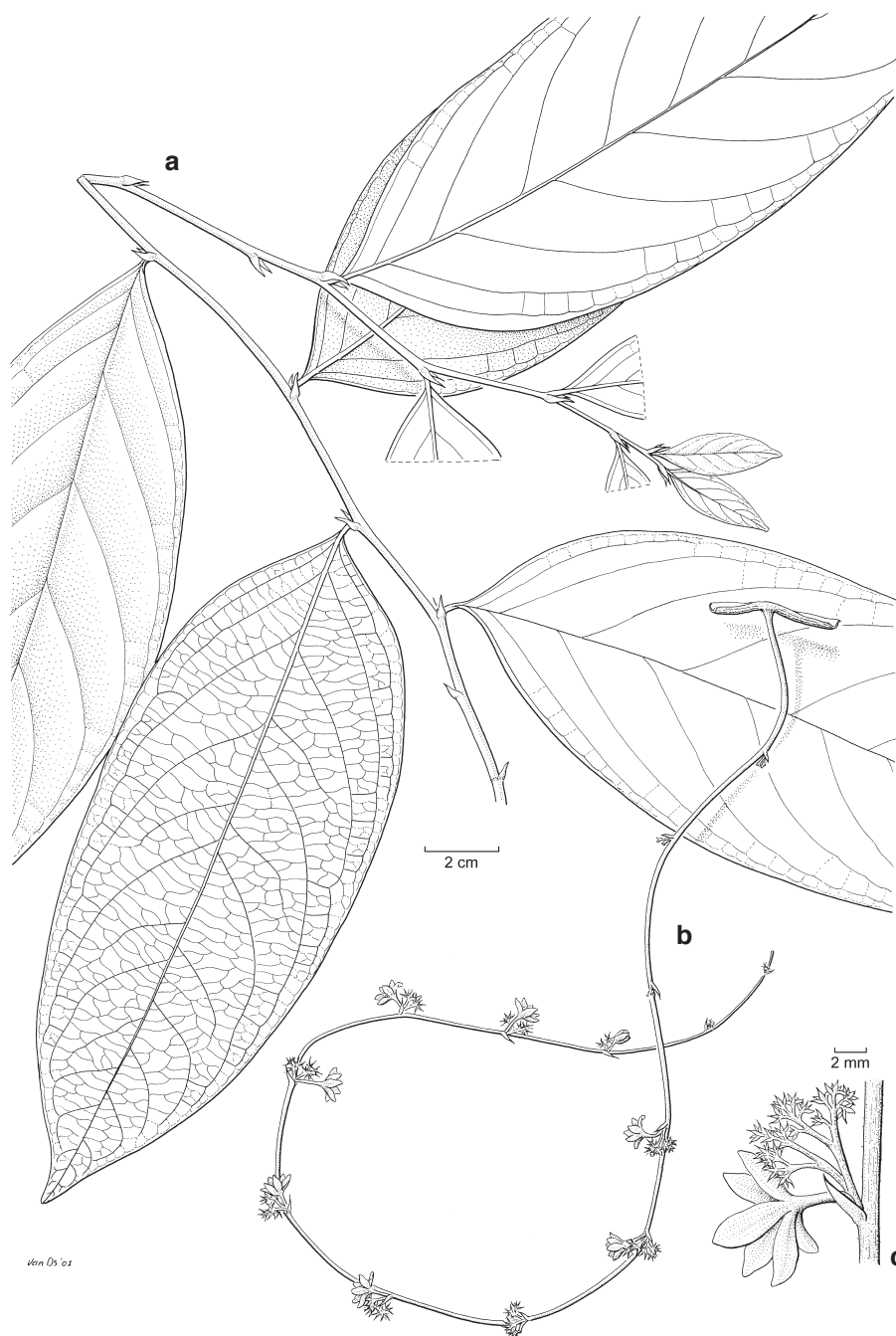


Fig. 9. *Sauropus thyrsoflorus* Welzen. a. Habit; b. inflorescence; c. detail of inflorescence with large pistillate flower at node and cymosely branching staminate flowers (a: Maxwell 96-499, L; b, c: Maxwell 96-74, A).

4.3–7.5 mm long, calyx 2.3–2.8 mm deep, lobes almost free, elliptic, 1.6–2.5 by 1–1.6 mm, thick, apex emarginate, scales very high, broad and distinct (broader than lobes); stamens: androphore 0.2–0.7 mm long, anthers c. 0.4 by 0.4 mm. *Pistillate flowers* 6–7 mm diam.; pedicel 2–4 (–7 in fruit) mm long; calyx lobes almost completely free, thick, outer ones elliptic to obovate, 2.2–3.5 by 1.2–3.3 mm, inner ones ovate, 1.1–1.2 by 1.2–1.5 mm; ovary ribbed; stigmas up to 1.2 mm long, horizontal, split and somewhat curved in upper half. *Fruits* c. 7 by 4 mm, with rows of asperities when young (Beille, 1927).

Distribution — Endemic to Laos; cultivated in northern Thailand.

Habitat & Ecology — Unknown. In cultivation: altitude 300 m. Flowering: August.

Vernacular names — Thailand: Khai khom, saliam hom (accepted Thai name).

Uses — Leaves edible, bitter; cultivated for its fragrant flowers (Airy Shaw, 1979).

### 31. *Sauropus thyrsoiflorus* Welzen — Fig. 9; Map 14

*Sauropus thyrsoiflorus* Welzen (2001) 503, f. 2. — Type: *Maxwell 94-499* (holo L; iso A), Thailand, (south-western) Kanchanaburi, Sangklaburi Distr., Lai Wo Subdistr., Toong Yai Naresuan Wildlife Reserve, Ban Sanah Pawng area (Karen hilltribe village).

*Sauropus bonii* auct. non Beille: Airy Shaw (1972).

Treelet, up to 3 m tall, basal diameter up to 20 cm; young branches without ribs; flowering branches 11–20 mm thick; sometimes smell of fenugreek. *Indumentum* absent. *Bark* thin, smooth to rather rough, finely pustular-lenticellate, dark grey to tan to dark brown. *Stipules* triangular, 6.5–8 by 1.7–3 mm, basally eared, pergamentaceous, persistent. *Leaves*: petiole 4–5 mm long, pulvinate, flattened above and with 3 longitudinal ridges; blades elliptic, 6.5–26 by 2.7–8 cm, length/width ratio 2–3.7, papery, base attenuate to cuneate, margin flat, apex acuminate to cuspidate, mucronulate, upper surface dark green, glossy, lower surface light green, not papillate; venation distinct on both sides, nerves 10–12 per side, veins and veinlets reticulate. *Inflorescences* cauliflorous to ramiflorous, thyrsoid, up to 12–51 cm long, rachis dull dark pink, with per node basally a single pistillate flower and cymose branches with staminate flowers, up to 5 mm long. *Staminate flowers* 6–7 mm diam., buds light green; pedicel c. 5.5 mm long; calyx 3–3.5 mm deep, dull pale light pinkish, lobes triangular, 2–2.2 by 1.5–2.1 mm, basally dull red inside, apex acute, scales as wide as lobes, thin; stamens: androphore 0.2–0.3 mm high, connectives dull light pinkish, anthers c. 0.4 by 0.4 mm. *Pistillate flowers* 11–12 mm diam.; pedicel 3–6 mm long; calyx almost completely lobed, lobes elliptic, thick, light greenish to yellow, apex usually acute, outer lobes 5.5–6 by 3.3–4 mm, inner lobes 4.8–5.5 by 3.3–4 mm; ovary cup-shaped, 1.2–2.3 by 1.8–2.7 mm, light yellowish to pale light pinkish; stigmas up to 2 mm long, horizontal, split for up to 1 mm, forming more than a circle. *Fruits* c. 19 by 15 mm, rather woody, with 6 longitudinal ridges. *Seeds* crescent-moon-shaped, sharply triangular in transverse section, c. 14 by 8 by 6 mm.

Distribution — Endemic in Thailand (Northern, Lampang Prov., and South-western floristic district, Kanchanaburi Province).

Habitat & Ecology — Shaded areas in evergreen and deciduous hardwood forest; rugged limestone terrain or limestone bedrock. Altitude 200–650 m. Flowering: January, April, May; fruiting: May.

Notes — 1. The species resembles *Sauropus micrasterias*. The latter has racemes or panicles with racemous staminate branches.

2. *Sauropus thyrsiflorus* also resembles *S. bonii* Beille, known from Indochina. Both species have very long cauliflorous inflorescences with short cymous branches with staminate flowers. However, the leaves of *S. bonii* are thicker, more ovate, less long and the staminate flowers have a hardly lobed calyx with obovate lobes (pistillate flowers not seen).

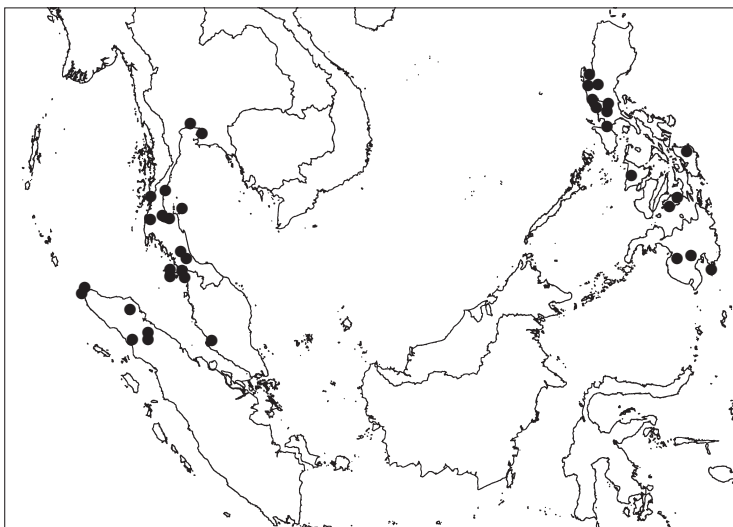
3. The plants from Kanchanaburi had much shorter inflorescences, but these still seemed young and can easily have become much longer. The leaves in Kanchanaburi are broader (length/width ratio up to c. 3), those in Lampang narrower.

### 32. *Sauropus villosus* (Blanco) Merr. — Map 21

*Sauropus villosus* (Blanco) Merr. (1934) 86; Airy Shaw (1969) 49; (1972) 339; Whitmore (1973) 130; Airy Shaw (1981) 343, f. 12A1–4; (1983) 44; Smitinand (2001) 468. — *Kirganelia villosa* Blanco (1837) 712; (1845) 493; (1879) 116, t. 399; Merr. (1918) 217. — Neotype (selected here): *Merrill Species Blancoanae* 931 (holo L; iso A, BM, K, NSW, NY, P, US), Philippines, Luzon, Rizal Province.

[*Phyllanthus pubescens* Klotzsch (1843) 420 [non Moon (1824) 65; non Wall. (1847) 7917 A, B], nom. illeg.] — *Glochidion llanosii* Müll.Arg. (1863) 68; Ridl. (1911) 173; Merr. (1923) 400. — *Phyllanthus llanosii* (Müll.Arg.) Müll.Arg. (1865) 387; (1866) 308. — *Sauropus llanosii* (Müll.Arg.) Gage (1922) 223; Ridl. (1924) 221; M.R. Hend. (1939) 30, 72. — Syntypes: *Cuming* 593 (n.v.), Philippines; *Cuming* 595 (G-DC, K), Philippines; *Llanos s.n.* (G-DC n.v., IDC microfiche DC herbarium 2473/18), Philippines, 1858; *Meyen s.n.* (K (ex-B, 2 sheets)), Philippines, Manila (the types of Klotzsch's *Phyllanthus pubescens* were not indicated and probably lost in B during the Second World War except for the *Meyen* specimens in K).

Woody herbs to shrubs, up to 2 m tall, dbh up to 2 cm; branches hirsute, light green, round, many, often longer than the stem; flowering branches 1–2 mm thick. *Indumentum* of simple hairs, hirsute, sparse to dense on most parts. *Stipules* triangular, 1.3–4 by 0.2–0.5 mm, subhirsute outside, glabrous inside. *Leaves* basally smaller than apically on branches; petiole 1.2–2 mm, dorsiventrally flattened, hairy; blade ovate, margins gradually tapering towards each other towards the apex, 1–6.5 by 0.6–1.9 cm, length/width ratio (1.5–)3.4, papery, not translucent, base emarginate to cuneate, sometimes somewhat oblique, margin often revolute, apex acute, often mucronulate, upper surface glabrous to subhirsute, especially when young, dark green, lower surface papillate, pale light green, sparsely to densely hairy; venation flat above, slightly raised below, nerves 9–13 per side, rather distinct, veins and veinlets rather indistinct, reticulate. *Inflorescences* axillary fascicles, flowers usually few (to many) together of same or mixed sexes. *Staminate flowers* 1–3 mm diam., yellow, glabrous except for a few hairs sometimes on pedicel and calyx outside; pedicel 1.2–4 mm long, glabrous; calyx flat, slightly 6-lobed, lobes up to 1.2 by 0.4 mm, hairy outside, glabrous inside; scales distinct or indistinct and united with lobes, providing a thick apex, apex usually erose; stamens erect, united along long side, androphore c. 0.2 mm long, pinkish, anthers 0.6–0.7 by c. 0.4 mm, connective sometimes slightly elongated. *Pistillate flowers* 1.2–2 mm diam., yellow-green (to white); pedicel 0.7–1 (–2.5 in fruit) mm long, hairy; calyx lobes 0.4–0.7 by 0.5–0.7 (in fruit up to 1.3 by 1.3) mm, yellow-green, apex acute, hairy outside, glabrous inside; ovary 0.7–1 by 0.8–0.9 mm, light green, glabrous; stigmas 0.6–1.2 mm long, horizontal, upper 0.5–0.7 mm free and in



Map 21. Distribution of *Sauropus villosus* (Blanco) Merr.

more than a complete circle, yellow green. *Fruits* flattened ellipsoid, 8–11 by 4–6 mm, broader than high, yellow to orangish red when mature, apically without a ring; column 1.2–2 mm long, tapering towards apex. *Seeds* triangular in transverse section, 4.5–5.5 by 3–4 by 2.8–3.2 mm.

**Distribution** — Thailand (South-eastern and Peninsular District), Vietnam (Annam), N Peninsular Malaysia, Sumatra, Philippines.

**Habitat & Ecology** — Locally abundant in especially disturbed sites like secondary growths, meadows, open thickets, scrubs, savannah, coconut plantations, open forest, but also in semi-deciduous forest; often near the sea shore; soil: sand. Altitude 0–600 m. Flowering and fruiting: September to June.

**Uses** — Philippines: The trunk makes good construction material for, for instance, flooring.

**Vernacular names** — Thailand: Ngap yai, tan ngan khao (official Thai name). Sumatra: Bebaho (Alas). Philippines: Lanitaga (Bisaya).

**Note** — The staminate scales are separate from the calyx lobes in Thailand, but in other areas they are grown together, giving a thick lobe apex with in the middle a constriction. The plants of Sumatra usually have a denser indumentum than those of other areas.

#### DUBIOUS SPECIES

*Sauropus convexus* J.J. Sm. (1924) 82. — Syntypes: Living collections at *Bogor Botanical Garden* XV.J.B.IV.1 († 1950), XV.J.B.V.5 († 1945), Indonesia, cultivated in Kebun Raya (Bogor Botanical Garden), originally from Leiden Botanical Garden.

**Note** — Probably a synonym of the very variable *S. androgynus* (or the closely related *S. rhamnoides*) to which it is compared by Smith. A correct interpretation of

this species is impossible, because the living plants already died several decades ago and no dried specimens were taken from them (absent in BO and in the Kebun Raya – Botanical Garden collections).

#### EXCLUDED SPECIES

*Sauropus elegantissimus* Ridl. (1926) 476; Whitmore (1973) 130. — Type: *Hume* 9366 (SING), Malaysia, Selangor, Ulu Gombak. = **Breynia retusa** (Dennst.) Alston.

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### IDENTIFICATION LIST

The numbers after the collector numbers refer to the following species:

- |                             |                              |
|-----------------------------|------------------------------|
| 1. <i>S. amabilis</i>       | 17. <i>S. micrasterias</i>   |
| 2. <i>S. amoebiflorus</i>   | 18. <i>S. orbicularis</i>    |
| 3. <i>S. androgynus</i>     | 19. <i>S. poomae</i>         |
| 4. <i>S. asteranthos</i>    | 20. <i>S. pulchellus</i>     |
| 5. <i>S. asymmetricus</i>   | 21. <i>S. quadrangularis</i> |
| 6. <i>S. bacciformis</i>    | 22. <i>S. rhamnoides</i>     |
| 7. <i>S. bicolor</i>        | 23. <i>S. rostratus</i>      |
| 8. <i>S. brevipes</i>       | 24. <i>S. shawii</i>         |
| 9. <i>S. calcareus</i>      | 25. <i>S. similis</i>        |
| 10. <i>S. discocalyx</i>    | 26. <i>S. spatulifolius</i>  |
| 11. <i>S. garrettii</i>     | 27. <i>S. sphenophyllus</i>  |
| 12. <i>S. granulatus</i>    | 28. <i>S. suberosus</i>      |
| 13. <i>S. heteroblastus</i> | 29. <i>S. subterblancus</i>  |
| 14. <i>S. hirsutus</i>      | 30. <i>S. thorelii</i>       |
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